DEPARTMENT OF
ECOLOGY
State of Washington

Technical Support Document for Second Tier Review

Titan Data Center
Moses Lake, Washington

April 28, 2011

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1. EXECUTIVE SUMMARY

Washington Administrative Code (WAC) 173-400-113(5) requires a proposed new source or modification to comply with the toxic air pollutant (TAP) regulations in Chapter 173-460 WAC.

RS Titan-Lotus, LLC (Titan) owns a multi-unit data server facility called the Titan Data Center located at 4949 Randolph Road NE, Moses Lake, (Grant County) Washington. Figure 1 shows a photograph of the existing Titan Data Center building. Titan submitted a Notice of Construction (NOC) application to the Washington State Department of Ecology Eastern Regional Office (ERO) on August 17, 2010, for a phased expansion of the Titan Data Center. The Titan Data Center expansion includes the addition of 14 new diesel engine-generator sets (generators) rated at 2.0 and 2.5 electrical-megawatts (MWe) and removal of two existing 650-kilowattt (kWe) engines. The new generators will have a combined electrical capacity of 32.5 MWe. Each engine will use its own 22.8-foot vertical exhaust stack.

The proposed generators will use U.S. Environmental Protection Agency (EPA) Tier 2 combustion controls to reduce emissions of particulate matter, oxides of nitrogen (NOx), including nitrogen dioxide (NO_2), unburned hydrocarbons, and other pollutants. In addition, to comply with the National Ambient Air Quality Standards (NAAQS) for NO_2, Titan will install 3-Way Oxidation Catalysts on each of the 14 new generators to reduce NOx emissions by at least 35%.

Figure 1. Photograph of the existing Titan Data Center building in Moses Lake, WA. (*courtesy of showcase.com*)

The Titan Data Center building currently houses server equipment and two 2000 kWe backup generators owned by Ask.com. The proposed expansion will add computer server capacity in a 3-story building. Multiple information technology tenants will lease space in the 3-story Titan Data Center building, and each tenant will use one or more of the proposed backup generators.

The Titan Data Center expansion will occur in two phases. Phase 1 is expected to be operational in 2011. The start date for Phase 2 is unknown at this time. Titan's permit application examines potential air quality impacts assuming both project phases are operational. The full buildout for combined Phase 1 and Phase 2 includes two existing Ask.com generators that will remain in place and fourteen new backup generators. In addition, the existing facility includes two existing generators that are out of service and will be permanently removed. In all, after the expansion is completed, there would be 16 generators on site to be used to supply emergency power during unplanned outages (assumed to be 8 hours/year of emergency outage) and for manufacturer-recommended engine testing.

Diesel engine exhaust contains thousands of gas, particle, and particle-bound constituents, including carbon dioxide, carbon monoxide, water vapor, oxides of nitrogen, saturated and unsaturated aldehydes and ketones, alkanes, alkenes, monocyclic aromatic hydrocarbons, carbon-core particles, metals, and gas- and particle-phase polycyclic aromatic hydrocarbons (PAHs) and PAH derivatives.[1]

Air dispersion modeling showed that Titan's proposed emissions of diesel engine exhaust particulates (DEEP) and NO_2 would produce ground-level concentrations exceeding their regulatory trigger levels listed in Chapter 173-460 WAC. These trigger levels are called Acceptable Source Impact Levels (ASILs). Because DEEP and NO_2 concentrations could exceed their ASILs, a second tier petition, WAC 173-460-090, is required to evaluate the potential health impacts of the project. This document describes the technical analysis performed by the Washington State Department of Ecology's Air Quality Program (Ecology).

Titan proponents retained ICF International Corporation (ICF) to complete the second tier petition on their behalf. Review of data in the Health Impact Assessment (HIA) conducted by ICF and of other data indicates DEEP emissions from Titan could result in an additional cancer risk of up to 2.3×10^{-6} (2.3 per million) for workers at the maximally impacted commercial receptor, which is the Columbia Basin Secondary School. This is the highest reasonable estimate of increased risk of lung and bladder cancer at any location in Titan's vicinity. The addition of Titan's emissions to existing diesel engine emissions in the area could reasonably be expected to increase overall DEEP-associated cancer risk to 7.5E-06 (7.5 per million). The amount of increased cancer risk from Titan itself is less than the state of Washington's threshold of maximum acceptable increased risk level (one in one hundred thousand or 10 per million) for a new project, as defined in Chapter 173-460 WAC. DEEP-associated risk from Titan and other sources of DEEP in the area are likely to less than the USEPA guideline of 100 per million for people in areas affected by multiple sources of a given carcinogen.

[1] http://www.arb.ca.gov/toxics/dieseltac/part_a.pdf

The analysis also indicates the potential for Titan's NO_2 emissions to induce breathing problems in sensitive people under certain circumstances. It is possible that some of the people with asthma near the Titan Data Center will occasionally experience acute breathing impairment primarily due to NO_2 from background sources and Titan. Currently, there is no numerically defined acceptable limit of non-cancer adverse health risks. Given records of past power failures at data centers in the Grant County PUD system and the 8-hour/year limit on diesel generator operation for emergencies, the chance of severe asthma effects occurring will be very low.

Given the low lifetime risk of severe asthma symptoms from Titan NO_2 emissions and the probably infrequent recurrence of high NO_2 exposure situations, Ecology concludes that additional mitigation measures are unnecessary; however, Ecology will need routine reports of power failures at Titan to determine the veracity of assumptions in this analysis. The reports shall include the date, time and duration of each power outage and the length of time that each engine operates as a result of the outage. Ecology will also use the power outage records to verify compliance with the 8 hours/year limit on emergency operations. Based on actual power outage records, Ecology may re-evaluate the health risks from this project and, if necessary, consider a permit amendment if it is determined that unplanned outages occur more frequently than was assumed in this analysis.

Ecology also recommends that Titan schedule a meeting with Columbia Basin Secondary School administrators prior to installation of the engines. The purpose of the meeting will be to communicate, and better understand, any potential concerns or complaints that the school may have regarding generator maintenance testing and operation. The meeting should also be used to communicate potential risks from generator operations. Titan should provide the school administrators with a direct telephone contact to one of the Titan Data Center managers. The school administrators should also be provided a maintenance-testing schedule for the generators. Titan will update the school whenever the testing schedule changes. As decided by the school administrators and Titan, an ongoing relationship between the school and Titan should be established.

Therefore, based on the technical analysis described below, and provided (1) health risks posed by Titan operations are communicated to new residences, which will be built in the most heavily impacted parcel immediately north of the Titan Data Center, (2) the proposed engines are operated no more than described herein; (3) the emission rates relied upon for modeling ambient impacts of Titan's project are not exceeded; and (4) Titan communicates with the school administrators about potential NO_2 impacts, the additional health risks attributable to Titan's DEEP and NO_2 emissions will be permissible under Chapter 173-460 WAC.

2. PERMITTING PROCESS OVERVIEW

2.1. The Regulatory Process

The requirements for performing a toxics screening are established in Chapter 173-460 WAC. This regulatory code requires a review of any increase in toxic emissions for all new or modified stationary sources in the state of Washington.

2.1.1. The Three Tiers of Permitting Toxic Air Pollutants

The objectives of permitting toxic air pollutants are to establish the systematic control of new sources emitting toxic air pollutants in order to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality as will protect human health and safety.

There are three levels of review when processing a new or modified emissions unit emitting TAPs: (1) first tier (toxic screening), (2) second tier (health impact assessment), and (3) third tier (risk management decision).

All projects are required to undergo a toxics screening (first tier review) as required by WAC 173-460-040. There are two ways to perform a first tier review. If proposed emissions are below the Small Quantity Emission Rates (SQERs) found in WAC 173-460-150, no further analysis is required. If emissions are greater than the SQERs, those emissions must be modeled and the resultant ambient concentration compared against the appropriate ASIL. If the ambient concentration is below the ASIL, then no further analysis is required.

A second tier review, required by WAC 173-460-090, is a site-specific health impact assessment. The objective of a second tier review is to quantify the increase in lifetime cancer risk for persons exposed to the increased concentration of any carcinogenic TAP and to quantify other increased health hazards from any TAP in ambient air that would result from the proposed project. Once quantified, the cancer risk is compared to the maximum risk allowed under a second tier review, which is one in one hundred thousand, and the concentration of any TAP that would result from the proposed project is compared to non-cancer health risk-based concentration values (RBC).

If the emission of a TAP results in additional cancer risk greater than one in one hundred thousand, or Ecology finds that other health hazards are not acceptable, an applicant may request Ecology perform a third tier review. A third tier review is a risk management decision made by the director of Ecology about whether or not the health risks posed by a project are acceptable. The decision is based on a determination that emissions will be maximally reduced through available preventive measures, assessment of environmental benefits, disclosure of risks at a public hearing, and related factors associated with the facility and the surrounding community.

The proposed Titan Data Center expansion triggers second tier review because the project's diesel engines could emit DEEP and NO_2 at levels that exceed their ASIL.

2.1.2. Second Tier Review Processing Requirements

Processing requirements for second tier petitions are found in WAC 173-460-090(2). Ecology shall evaluate a source's second tier petition only if:

(i) The permitting authority submits to Ecology a preliminary order of approval that addresses all applicable new source review issues with the exception of the outcome of second tier review, State Environmental Policy Act review, public notification, and Prevention of Significant Deterioration review (if applicable);

(ii) Emission controls contained in the preliminary approval order represent at least Best Available Control Technology for Toxics (tBACT);

(iii) The applicant has developed a HIA protocol that has been approved by Ecology;

(iv) The ambient impact of the emissions increase of each TAP that exceeds its ASIL has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol; and

(v) The second tier petition contains a HIA conducted in accordance with the approved HIA protocol.

Ecology first received the second tier review petition for nitrogen dioxide and diesel particulate matter electronically on August 12 and 13, 2010, and by regular mail on August 17, 2010. ICF submitted to Ecology three documents titled:

1. "Notice of Construction Support Document: Titan Data Center, Moses Lake, WA"
2. "Second-Tier Risk Assessment for Diesel Particulate Matter: Titan Data Center, Moses Lake, WA"
3. "Second-Tier Risk Assessment for Nitrogen Dioxide (NO_2): Titan Data Center, Moses Lake, WA"

ERO submitted a preliminary Notice of Construction (NOC) Order of Approval for the project to Ecology on October 6, 2010. ERO submitted a revised preliminary order of approval to Ecology on January 19, 2011. Ecology considers the preliminary order of approval to satisfy items (i) and (ii) above.

ICF did not submit a health impacts analysis protocol (items (iii) and (iv) above) for the proposed project. Lack of item (iii) above caused additional work for Ecology and delayed review of the HIA.

The documents and electronic files submitted by ICF as of August 30, 2010, contained nearly sufficient information to perform a health impacts review in accordance with standard risk assessment procedures. Ecology made multiple requests for additional information necessary to complete review of health risks posed by the project. ICF subsequently sent additional information in a series of e-mails and electronic files. Ecology deemed Titan's second tier petition complete on October 7, 2010 but upon close reading of the petition, Ecology found that it needed clarifications. On about December 3, 2010, Ecology completed its report of the risk analysis and recommended approval of the project subject to several conditions.

On about December 14, 2010, Titan proponents objected to the conditions and responded by reducing their proposed generator operation time from 48-h to 8-h per year for unplanned outages. ICF revised the Notice of Construction Support Document and the Second-Tier Risk Assessments for DEEP and nitrogen dioxide to account for reduced power outage time. Ecology received the revised NOC application and second-tier risk assessments for DEEP and nitrogen dioxide on January 4, 2011. In the revised NOC application, Titan also requested up to 30 hours per year per engine of operation for occasional non-emergency "electrical bypass maintenance".

On April 12, 2011, AQP-HQ received from ICF an altered proposal for the Titan Datacenter project. This new document is titled *Notice of Construction Support Document (Revised for NOx Controls and 14-Generator Configuration) Titan Data Center, Moses Lake, WA, April 2011.* Highlights of this revised proposal are that it is for 14 new generator engines instead of the 16 proposed in the project's December 2010 permit application. Also, Titan proposes installation of 3-way diesel oxidation catalysts that, the manufacture guarantees, will reduce NOx emissions by 35% (ICF quotes the device vendor's assertion that DEEP, NO_2 and other TAP emission impacts will be less as a result of this control device).

Together, the HIA and supporting files presented overviews of air dispersion modeling and health hazards assessments and predictions about subsequent health risks for the Titan Data Center. Accordingly and with reservations, Ecology decided item (v) above is immaterial in this case.

In summary, Titan and ERO satisfied four of the five requirements listed above. Although lack of item (iii) significantly affected the length of time Ecology spent reviewing Titan's project, we do not believe that submission of that information would lead to different conclusions regarding health risks attributable to the proposed project.

3. FACILITY INFORMATION

3.1. Facility Location

The Titan Data Center is located in north Moses Lake, 0.2 miles south of the Grant County International Airport. Figures 2 and 3 show the data center in relation to the surrounding area. The Titan Data Center occupies a 120,000-foot^2 building consisting of three floors that are being prepared for occupancy by companies that require fully supported data storage and processing space. Besides office space on the first floor utilized by the Titan Data Center, there are currently two tenants. Ask.com occupies sections of the first and second floors that are utilized for data storage and processing. The Bonneville Power Administration occupies a relatively small space on the first floor that contains communications equipment.

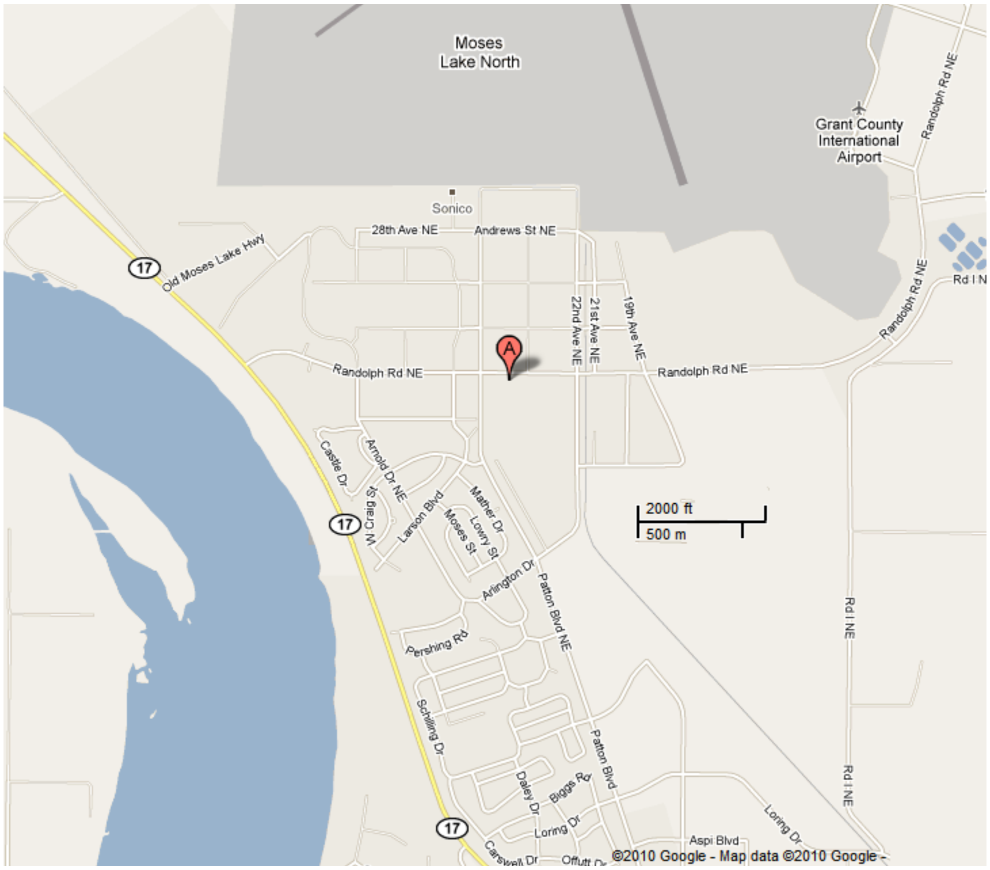

Figure 2. Map showing the location of the Titan Data Center and surroundings. (The data center is at marker "A.")

3.2. Permitting History

Ecology issued NOC approval Order No. 07AQ-E236 to Ask.com on November 5, 2007. Order No. 07AQ-E236 was amended by Ecology on December 4, 2007. The Order approved the installation and limited operation of two Caterpillar Model 3516CDITA emergency generators with a combined capacity of 5.0 MWe. The two Ask.com engines are limited to 672 hours per year of full standby operation, which equates to approximately 115,584 gallons of diesel fuel per year. Emergency power is currently provided by two existing diesel fueled 650 kilowatt (kWe) generators that are owned and operated by the Titan Data Center. Those two generators were originally installed by the United States Department of Defense (USDOD) in the 1960s and pre-date air quality permitting requirements in Grant County.

Figure 3. Satellite photo of Titan Data Center, its surroundings, and nearby buildings. *(Source: ICF with additional labeling by Ecology*)

3.3. The Proposed Project

The Titan Data Center expansion includes the addition of 14 new Cummins Model QSK60 and QSK78 engines used to power 2000DQKC and 2500DQLC diesel generator sets. The generator sets are rated at 2.0 and 2.5 electrical-megawatts (MWe), respectively, and will have a combined capacity of 32.5 MWe. Annual operations will be restricted by limitations on fuel consumption and hours of operation.

The generators will be installed in two construction phases. Phase 1 will consist of three 2.0 MWe generators that will be installed upon approval. Phase 1 construction will also replace emergency power from the two existing 650 kWe, which will be rendered inoperable and removed. Phase 2 will consist of thirteen 2.0 to 2.5 MWe generators to be installed at the facility as independent companies contract for space at the Titan Data Center. The two existing 2000 kWe Ask.com generators will remain in place. There is no other project equipment that requires review under the state and federal air quality requirements.

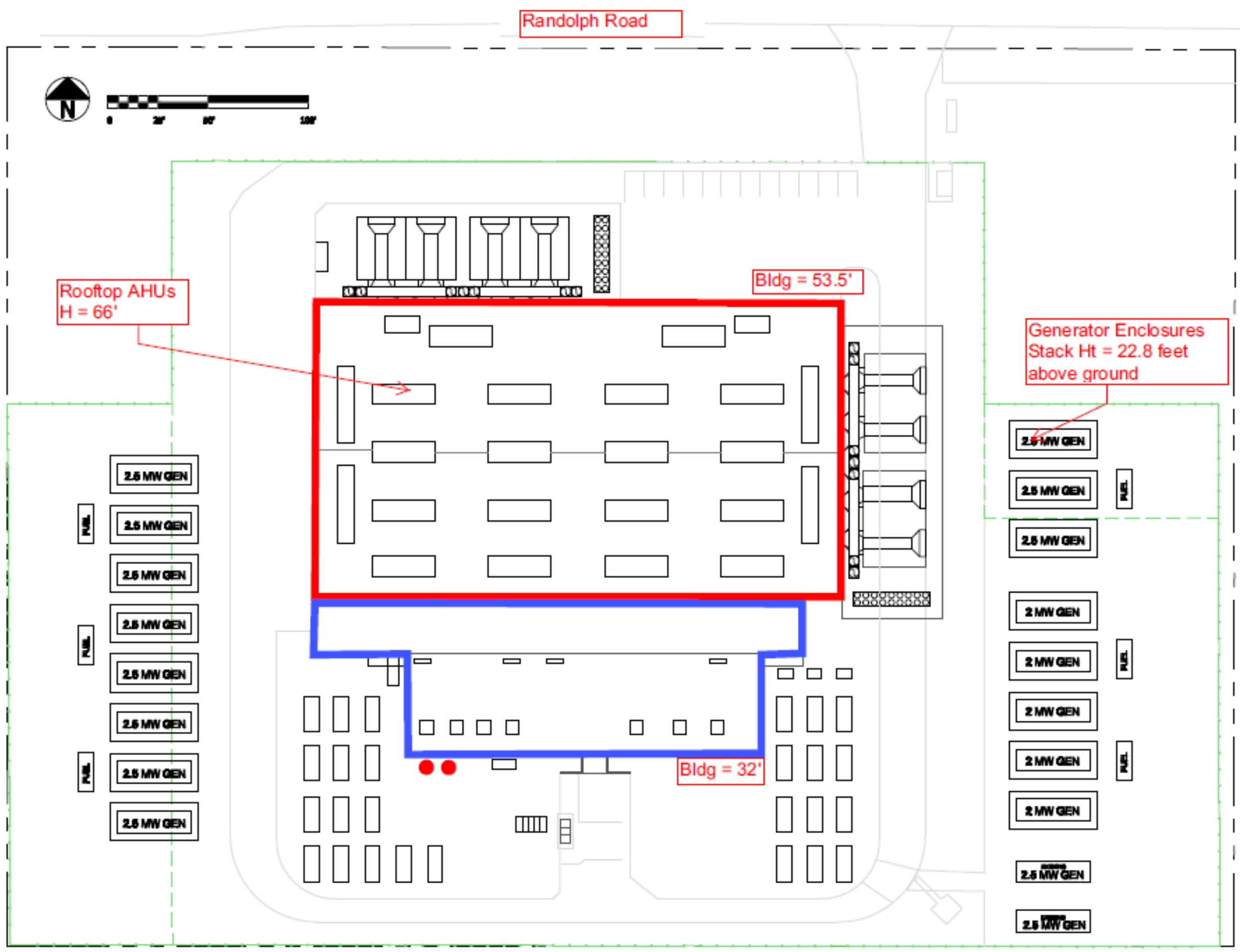

Figure 4. Titan Data Center site plan for the 16-generator configuration. The 14-generator configuration adds a 9th 2,500 kWe generator for Tenant 3 on the west side of the building, and removes the top three 2,500 kWe generators from the east side. *(Source: ICF)*

Phase 1 construction is expected to be completed in 2011. The start date for Phase 2 construction is to be determined. The current health impacts evaluation is for a potential full build-out configuration that would add 14 generators as a combination of 2,000 kWe and 2,500 kWe Cummins generators (for a total of 16 generators at the facility). Each generator will be inside its own acoustical enclosure at ground level and will use its own 22.8-foot, 18-inch inside diameter, vertical exhaust stack. The new generators will be on the east side and the west sides of the main data center building similar to the positions shown in Figure 4.[2]

Titan stated in the application that operation of the engines would fall into four categories as shown in Table 1: monthly pre-scheduled diagnostic testing for a short duration at low load, annual load bank testing at design load, non-emergency electrical bypass maintenance, and emergency operation to provide power to the facility during unplanned outages.

Table 1. Forecast Engine Usage for the Titan Data Center

Generator			Scheduled Generator Testing					Electrical Bypass Maintenance			Unplanned Outage	
Gen #	Gen Area	Gen Size	Monthly Tests			Annual Tests (Load Bank)		Non-emergency usage (Limited to no more than 8 engines any given time)			Average Load During Outage	Unplanned Outage hours
		kWe	% Elec Load	hrs/test	Tests/yr	% Elec Load	hrs/yr	% Load	hrs/event	Events/yr	%	hours/yr
A	Existing	2000	50%	1	11	100%	4	40%	0	0	40%	8
B	Existing	2000	50%	1	11	100%	4	40%	0	0	40%	8
1	Ph 2, 2-1	2000	50%	1.5	11	100%	4	64%	10	3	64%	8
2	Ph 2, 2-1	2000	50%	1.5	11	100%	4	64%	10	3	64%	8
3	Ph 2, 2-1	2000	50%	1.5	11	100%	4	5%	10	3	5%	8
4	Ph 1, 1-3	2000	50%	1.5	11	100%	4	64%	10	3	64%	8
5	Ph 1, 1-4	2000	50%	1.5	11	100%	4	64%	10	3	64%	8
6	Ph 1, 1-2	2500	50%	1.5	11	100%	4	47%	10	3	47%	8
7	Ph 1, 1-2	2500	50%	1.5	11	100%	4	47%	10	3	47%	8
8	Ph 1, 1-2	2500	50%	1.5	11	100%	4	47%	10	3	47%	8
9	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
10	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
11	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
12	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
13	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
14	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
15	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
16	Ph 3, 3-1	2500	50%	1.5	11	100%	4	59%	10	3	59%	8
C	To be removed	650	62%	1	11	62%	4	62%	0	0	62%	8
D	To be removed	650	62%	1	11	62%	4	62%	0	0	62%	8

(*Source: "Dec-NOC-Support_Titan_12-30-10_jmw corrections on figures.doc"*)

As summarized in Table 1, Titan's protocol for scheduled testing and planned and unplanned outages involves:

[2] In their April, 2011 revision to the NOCSD, ICF updated the intended placement positions of the generators. However, Ecology did not substitute the resulting figure with the older one shown in Figure 4 because the changes were minimal. Likewise, data shown in Table 1 were updated by ICF to express the revised number of engines in the altered project proposal, but Ecology did not substitute the resulting new table herein.

1. Monthly testing for 1.5 hours per test per engine, with each engine running one at a time at 50% load. The December revision to the NOC support document states each tenant will conduct monthly testing according to their own schedule;
2. Annual load-bank testing for four hours per year per engine, with each engine tested one at a time while running at 100% load. The December revision to the NOC support document states each tenant will conduct load bank testing according to their own schedule;
3. Occasional, pre-scheduled electrical bypass (non-emergency) maintenance operation of 8 or less engines at a time at 47 to 64 percent load for up to 30 hours per engine per year. During electrical bypass maintenance, one engine (Generator 3) will activate but would run at idle to serve as a standby unit. Electrical bypass operation is expected to occur no more frequently than every other year or perhaps every three years. In that case, each tenant would work on only their own electrical system and they would activate only their own generators. In no case would any tenant use more than 8 generators at any given time for this activity. The December revision to the NOC support document states each tenant will conduct bypass maintenance according to their own schedule;
4. Unplanned outage operation, limited to eight hours per year per engine, at 47 to 64 percent load. During a full unplanned power outage, 13 of the 14 engines would activate at 47 to 64 percent load, while one unit (Generator 3) would activate but would run at idle to serve as a standby unit.

Titan has not requested to run their engines for “storm avoidance” as is common in some data center operations. The proposed engines will primarily be operated for “emergency” purposes. While Ecology’s technical analysis assumes the proposed engines will serve as “emergency generators,” Ecology is not making a determination that the proposed diesel engines qualify as “emergency engines” as defined in U.S. Environmental Protection Agency (EPA) regulations. Rather, Ecology’s analysis is based on the estimated worst-case emissions from engine use.

4. POLLUTANT SCREENING

4.1. Emissions

Diesel engine exhaust contains thousands of gas, particle, and particle-bound constituents, including carbon dioxide, carbon monoxide, water vapor, oxides of nitrogen, saturated and unsaturated aldehydes and ketones, alkanes, alkenes, monocyclic aromatic hydrocarbons, carbon-core particles, metals, and gas- and particle-phase polycyclic aromatic hydrocarbons (PAHs) and PAH derivatives.[3]

[3] http://www.arb.ca.gov/toxics/dieseltac/part_a.pdf

Using emission factors for diesel-fueled engine electric generators published in AP-42[4], Caterpillar and 40 CFR §89.112, ICF estimated TAP emissions from the proposed Titan Data Center expansion. The emission rates in Table 2 are consistent with the preliminary NOC approval order, dated September 29, 2010.

As disclosed in the original proposal NOCSD, emissions of five TAPs (DEEP, acrolein benzene, carbon monoxide, and nitrogen dioxide) exceed their SQERs. In their April, 2011 revision to the NOCSD, ICF updated several details of the project involving the generators. These updates indicate relatively lower amount of TAP emissions. Ecology re-issued a draft preliminary NOC approval order on April 22, 2011. However, we did not adjust the information in Table 2 of this report because the revised preliminary order does not grant higher emissions than originally proposed in the September 29, 2010 draft Order.

Table 2. Comparison of Titan's Forecast Maximum TAP Emission Rates to Small Quantity Emission Rates (SQERs)

Toxic Air Pollutant	CASRN	Conc. Time Wtd. Avg. Period	SQER (lb/TWP)	Maximum Emissions Rate (ER) (lbs/TWP)	Emission Rate > SQER?	ER/ SQER
DEEP		year	0.639	610	Yes	955
1,3-Butadiene	106-99-0	year	1.13	0.242	No	-
Acetaldehyde	75-07-0	year	71	0.312	No	-
Acrolein	107-02-8	24-hr	0.00789	0.013	Yes	1.7
Benzene	71-43-2	year	6.62	9.64	Yes	1.46
Benzo(a)anthracene	56-55-3	year	1.74	0.0077	No	-
Benzo(a)pyrene	50-32-8	year	0.174	0.0016	No	-
Benzo(b)fluoranthene	205-99-2	year	1.74	0.0138	No	-
Benzo(k)fluoranthene	207-08-9	year	1.74	0.0014	No	-
Chrysene	218-01-9	year	17.4	0.019	No	-
Carbon monoxide	630-08-0	1-hr	50.4	177	Yes	4
Dibenzo(a,h)anthracene	53-70-3	year	0.16	0.0021	No	-
Formaldehyde	50-00-0	year	32	0.98	No	-
Indeno(1,2,3-cd)pyrene	193-39-5	year	1.74	0.0026	No	-
Nitrogen dioxide	10102-44-0	1-hr	1.03	30.9	Yes	30
Sulfur dioxide	7446-09-05	1-hr	1.45	0.08	No	-
Toluene	108-88-3	24-hr	657	0.472	No	-
Xylenes	95-47-6, 106-42-3, 108-38-3	24-hr	29	0.324	No	-

(Sources: "Titan NOC Support Document, Summary of Emissions table in Appendix B" and "Dec-NOC-Support_Titan_12-30-10_jmw corrections on figures.doc")

[4] http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf

4.2. Best Available Control Technology for Toxics (BACT)

Ecology is responsible for establishing BACT and tBACT for the new diesel generators. The proposed generators will use EPA Tier 2 combustion controls to reduce emissions of particulate matter, oxides of nitrogen (NO_X), including nitrogen dioxide (NO_2), unburned hydrocarbons, and other pollutants. Additionally, to assure compliance with the NO_2 NAAQS, Titan has proposed to use specially-designed 3-way diesel oxidation catalysts to control NOx emissions from each engine. Ecology's BACT and tBACT determinations are summarized in Tables 3 and 4, respectively.

Table 3. Summary of BACT Determination

Pollutant(s)	BACT Determination
Particulate matter (PM), carbon monoxide and volatile organic compounds	a. Use of good combustion practices; b. Use of EPA Tier 2 certified engines if the engines are installed and operated as emergency engines, as defined at 40 CFR§60.4219; or applicable emission standards found in 40 CFR Part 89.112 Table 1 and 40 CFR Part 1039.102 Tables 6 and 7 if Model Year 2011 or later engines are installed and operated as non-emergency engines; c. compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII; and d. Compliance with the NOx BACT requirement.
Nitrogen oxides (NOx)	a. Use of good combustion practices; b. Use of an engine design that incorporates fuel injection timing retard, turbocharger and a low-temperature aftercooler; e. Use of EPA Tier 2 certified engines if the engines are installed and operated as emergency engines, as defined at 40 CFR§60.4219; or applicable emission standards found in 40 CFR Part 89.112 Table 1 and 40 CFR Part 1039.102 Tables 6 and 7 if Model Year 2011 or later engines are installed and operated as non-emergency engines; c. Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII; and d. Installation of a two-stage oxidation catalyst system (i.e., 3-way catalysts) that is guaranteed by the catalyst manufacturer to remove 35% of nitrogen oxides, and capable of reducing at least 50% each of carbon monoxide, volatile organic compounds and particulate matter from the exhaust stream.
Sulfur dioxide	Use of ultra-low sulfur diesel fuel containing no more than 15 parts per million by weight of sulfur.

Table 4. Summary of tBACT Determination

Toxic Air Pollutant(s)	tBACT Determination
Acetaldehyde, carbon monoxide, acrolein, benzene, benzo(a)pyrene, 1,3-butadiene, diesel engine exhaust particulate, formaldehyde, propylene, toluene, total PAHs, xylenes	Compliance with the VOC BACT requirement
Nitrogen dioxide	Compliance with the NOx BACT requirement
Sulfur dioxide	Compliance with the SO_2 BACT requirement

Additional restrictions proposed by Ecology in the April 22, 2011 draft preliminary approval order include:

- Limiting DEEP emissions from the 14 new engines (combined) to 0.262 tons per year.
- Limiting NO_2 emissions from the 14 new engines (combined) to 20.2 pounds per hour.
- Limits on the total amount of hours that engines operate.
- Use of ultra-low sulfur diesel fuel (15 parts per million sulfur content).
- Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII.
- Limits on NOx and NO_2 emissions from each of the 14 new engines.

4.3. Air Dispersion Modeling

ICF conducted air dispersion modeling for Titan Data Center's generators to demonstrate compliance with ambient air quality standards and acceptable source impact levels. The generators were modeled as multiple discharge points. ICF used AERMOD (Version 09292), with EPA's PRIME algorithm for building downwash, to determine worst-case ambient air quality impacts caused by emissions from the proposed generators at the property line and beyond, and at the rooftop of the commonly occupied data center building.

4.3.1. Ambient Air Quality Compliance Boundary

Multiple information technology tenants will lease space in the three-story Titan Data Center building, and each tenant will use one or more of the backup generators that are the subject of this permit application. Intake air for the entire building is taken from the air handling units on the building rooftop.

Ecology directed ICF to assume that for purposes of AERMOD modeling, the air quality compliance boundary consists of:

- All locations beyond the facility boundary, regardless of whether they are occupied.
- The rooftop of the onsite data center building, which is occupied by multiple tenants. All ventilation air fed to the data center building is taken from the rooftop air handling systems at the rooftop. Therefore, the rooftop represents the source of public air that is used by all tenants inside the building. An AERMOD receptor was placed on the rooftop.

Ecology did not require a demonstration of compliance with ambient air quality standards at outdoor common areas located within the facility boundary because:

- The parking areas and other outdoor areas inside the property boundary will not be exclusively leased to any individual tenant. The entire outdoor common areas will be shared by all tenants.
- Tenants will be free to use any outdoor parking space within the property. There will not be posted signs or other barriers that restrict tenant parking to specific areas or that forbid specific tenants from certain outdoor areas within the property. Therefore, each tenant will jointly utilize the common areas.
- Titan will maintain a physical fence around the entire property. The fence will restrict general public access to the outdoor areas.
- Each of the tenants will undertake their own separate actions in collaboration with Titan to ensure that public access is restricted in the outdoor areas. These individual actions may be in the form of specific provisions in the lease agreement that preclude general public access and require a physical barrier to be maintained around the Titan property.

4.3.2. AERMOD Dispersion Modeling Methodology

The AERMOD model used the following data and assumptions:[5]

a) Five years of sequential hourly meteorological data (2004-2008) from Moses Lake were used.

b) Twice-daily upper air data from Spokane were used to define mixing heights.

c) Digital topographical data (in the form of Digital Elevation Model files) for the vicinity were obtained from the Micropath Corporation. 2001 National Land Cover (NLCD2001) land use data.

d) The data center building was included to account for building downwash.

e) The receptor grid for the AERMOD modeling was established using a 10-meter grid spacing along the facility boundary extending to a distance of 300 meters from the north and south sides of the facility boundary, and about 200 meters from the east and

[5] See NOC application and second tier petition support documents.

west sides of the facility boundary (i.e., within approximately a 350 meter range of all generators).

f) One-hour NO_2 concentrations were modeled using the Plume Volume Molar Ratio Method (PVMRM) module, with default ozone concentrations of 40 parts per billion (ppb), and an equilibrium NO_2/NO_X ambient ratio of 90 percent. For purposes of modeling NO_2 impacts, the primary NO_X emissions were assumed to be 10% NO_2 and 90% nitric oxide (NO) by mass.

g) For this analysis, AERMOD/PVMRM was run using 14 different generator stacks each with its assigned engine size, engine load, stack diameter, stack height, stack temperature, stack velocity, and maximum 1-hour NOx emission rate. The generators were assumed to operate for continuously at their assigned load for 24 hours, 7 days per week, 365 days per year for each of the five years. AERMOD then specified the 1st-highest 1-hour NO_2 impact location and magnitude. The maximum impact per year and the number of hours for which the ASIL was exceeded during the five-year simulation period were recorded.

h) The 1st-highest 1-hour NO_2 concentrations during a full power outage were modeled to assess compliance with the ASIL. Because a power outage could occur at any time on any day, all 14 new generators were modeled at their design loads continuously, for 24 hours per day and 365 days per year for the five years of meteorology used in the analysis. The AERMOD/PVMRM was set to indicate the 1st-highest 1-hour value for each separate modeling year.

4.3.3. Compliance With the 1-Hour NO_2 National Ambient Air Quality Standard (NAAQS)

In 2010, EPA established a new 1-hour NAAQS for NO_2, set at 100 parts per billion (ppb) or approximately 188 $\mu g/m^3$. The new 1-hour standard is intended to protect against short-term exposure to high NO_2 concentrations, particularly near major roadways. The new NO_2 standard establishes a new 1-hour averaging period for the NO_2 NAAQS. To comply with the 1-hour NO_2 NAAQS, the three-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations at the ambient air receptor must be less than 100 ppb. The 1-hour NAAQS is designed to protect against health effects associated with short-term exposures to NO_2, which are generally highest on and near major roads.
During a full unplanned power outage, most of the generators would activate at design load, while other “redundant units” would initially activate but would run at idle to serve as a standby unit. The active generators are designed to run at loads of 47% to 64% during an outage. For this air quality permit it was assumed that only one generator would serve as the “redundant unit”. Depending on specific tenant needs, it is likely that they could require a lower electrical demand and could use more than one “redundant unit”. In that case the actual emission rates would be lower than the upper-bound rates assumed for this analysis.

Titan assumed the facility would experience 8 hours per year of unplanned power outages, and for estimating worst-case annual emissions, Titan assumed each tenant would conduct their occasional electrical bypass maintenance in the same worst-case year. For purposes of demonstrating compliance with the 24 hour NAAQS and the 24 hour ASILs, Titan further assumed the forecast 8 hours/year of power outages would occur on a single day. However, for purposes of the statistical "Monte Carlo" analysis used to demonstrate compliance with the 1-hour NO_2 NAAQS it was assumed there would be power outages lasting at least one hour on 4 days per year.

Figure 5. AERMOD receptor grid points *(Source: ICF)*

As shown in Figure 5, all receptor grid points were centered on the facility. Ecology requires that receptor grid points be placed at publicly accessible areas outside of Titan's property. Figure 5 indicates that Titan's property boundary extends a few meters beyond their fenced boundary in the east, west and north directions.

The NAAQS limits for 24-hour $PM_{2.5}$ and 1-hour NO_2 are both based on the 3-year average of the 98th percentile highest daily impact. This is equivalent to the eighth-highest operating day during each year. It is unlikely that the Moses Lake area would experience 8 major power failures in any given year. Therefore, for purposes of evaluating 24-hour average $PM_{2.5}$ impacts it was assumed the seventh (and eighth)-highest operating days in any year would consist of the routine monthly engine testing, which consists of each generator running one at a time on the same day for short duration at low load (1.5 hours at 50% load).

"Monte Carlo" modeling was used to model ambient 1-hour NO_2 impacts for purposes of complying with the NAAQS. That modeling approach is described below.

4.3.4. "Monte Carlo" Statistical Analysis for Demonstrating Compliance With the 1-Hour NO_2 NAAQS

The 1-hour NO_2 NAAQS is based on the 3-year rolling average of the 98th percentile of the daily maximum 1-hour NO_2 impacts. Data centers operate their generators on an intermittent basis under a wide range of engine loads, under a wide range of meteorological conditions. As such it is difficult to determine whether high-emitting generator runtime regimes coincide with meteorological conditions giving rise to poor dispersion, and trigger an exceedance of the 1-hour NO_2 NAAQS at any given location beyond the facility boundary. This issue was recently recognized by EPA when they stated that "[m]odeling of intermittent emission units, such as emergency generators, and/or intermittent emission scenarios, such as startup/shutdown operations, has proven to be one of the main challenges for permit applicants undertaking a demonstration of compliance with the 1-hour NO_2 NAAQS".[6]

To address this problem, Ecology developed a statistical re-sampling technique, that we loosely call the "Monte Carlo analysis". This technique performs a statistical analysis of the AERMOD-derived ambient NO_2 impacts caused by individual generator operating regimes, each of which exhibits its own NOx emission rates at various locations throughout the facility. The randomizing function of the Monte Carlo analysis allows inspection of how the combination of sporadic generator operations, sporadic generator emissions at various locations, and variable meteorology affect the modeled 98th-percentile concentrations at modeling receptors placed within the facility and outside the facility boundary.

The first step in the Monte Carlo NO_2 analysis was to use the AERMOD/PVMRM model for each representative generator runtime regime by each tenant at the Titan facility. To do so, 14 different generator operating regimes proposed by Titan were each modeled separately with AERMOD, using 5 years of meteorology (2004- 2008). For each of the 14 AERMOD runs, the number of calendar days per year of operation for that generator operating regime was established. To test the effect of initial startup and commissioning testing on ambient air quality, the NOx-emitting scenarios corresponding to the initial startup testing were included in the 2004 meteorological set. For all 5 years of modeling, it was assumed that all of the tenants conducted their scheduled maintenance each year. For each of the 5 modeling years, the existing emissions contributed by the existing Ask.com facility were included in the analysis. For each of the 5 modeling years, it was assumed there would be 4 random days on which power outages lasted at least 1 hour.

The Monte Carlo method then randomly selects the days on which the generators operated in each regime, combines the modeled concentrations on those days across all operating regimes and iterates the process 1000 times, so as to obtain a distribution of the possible concentrations at

[6] http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

each receptor. Compliance with the 1-hour NO_2 NAAQS was evaluated based on the median of the distribution of 98th percentile values calculated for each of the five years modeled. The analysis showed that the 1-hour NO_2 NAAQS is not likely to be exceeded if 3-way diesel oxidation catalysts are used to reduce more than 25% of in-stack NOx emissions from each engine.

4.4. Points of Compliance

The multi-tenant Titan Data Center building breathing air intake(s) and all publicly accessible ground-level land outside the Titan Data Center fence line are designated as the assumed points of maximum public exposure (nearest point of ambient air) to the proposed emissions.

4.5. Maximum TAP Concentrations

The predicted maximum emissions of DEEP, nitrogen dioxide, benzene, CO and acrolein from the Titan Data Center exceed their SQERs. ICF provided AERMOD predictions of DEEP and NO_2 concentrations at the Titan Data Center property boundary and beyond. These predictions show maximum concentrations occur at points about 200 feet outside the boundary.

Ecology estimated the concentration of benzene by multiplying the benzene concentration at the boundary disclosed in Table 6-3 of the NOC Support Document by the ratio of the DEEP extra-boundary concentration to the DEEP boundary concentration. Likewise, Ecology estimated the concentration of carbon monoxide by multiplying its concentration at the boundary by the ratio of the NO_2 extra-boundary concentration to the NO_2 boundary concentration.

Acrolein has a 24-h time weighted concentration averaging interval. This is between the 1-h and 1-year time-weighted average (TWA) intervals of NO_2 and DEEP; therefore, Ecology assumed acrolein's extra-boundary / boundary concentration ratio would be intermediate between these ratios. Based on the results, it appears the maximum extra boundary acrolein concentrations may be about one-tenth of its ASIL. ICF's reported TAP concentrations and Ecology's estimates are shown in Table 5.

Only those TAPs that exceeded their SQERs are shown in Table 5. The highest modeled off-site concentration of each TAP is compared to its respective ASIL.

The revised Titan project proposal, received by Ecology April 12, 2011, is for 14 new generator engines instead of the 16 proposed in the December 2010 project permit application. Also, the revised proposal includes installation of 3-way diesel oxidation catalysts that the device vendor asserts will reduce NOx emissions by 35% (ICF quotes the device vendor's assertion that DEEP, NO_2 and other TAP emission impacts will be less as a result of this control device). For purposes of emissions calculations, we assumed that the proposed control devices will reduce NOx emissions by 25%. We compared the revised facility TAP concentrations data, given in the April 2011 Notice of Construction Support Document (NOCSD) Table 6-9, to data in the December 2010 NOCSD, Table 6-7 (both tables are titled "ASIL Compliance at Facility Boundary"). The comparison is provided in Table 6.

Table 5. Estimated TAP Concentrations at Titan Property Boundary and Beyond given the original project proposal

TAP	Concentration TWA Period	ASIL	Maximum Boundary ($\mu g/m^3$)	Maximum Extra-Boundary ($\mu g/m^3$)	Extra-Boundary: Boundary Ratio	Extra-Boundary > ASIL? ($\mu g/m^3$)
DEEP	1-yr	0.00333	0.096	0.09732 (0.0845**)	1.014	Yes
Benzene	1-yr	0.0345	1.50E-03	1.52E-03*		No
CO	1-hr	23000	2536	2958.667*		No
NO_2	1-hr	470	678	791 (626**)	1.167	Yes
Acrolein	24-hr	0.06	0.0063 (0.0020**)	< 0.0073*		No

*Estimated based on Extra-Boundary / Boundary ratios of other TAPs. The acrolein Acute Reference Exposure Level (AREL) is 2.5-$\mu g/m^3$, 1-h TWA.
***(Source: "Dec-NOC-Support_Titan_12-30-10_jmw corrections on figures.doc")*

While the 34.8 and 14.79 percent respective NO_2 and DEEP reductions shown in Table 6 are significant, they are not enough to reduce the concentrations to less than their ASILs. Further, the reconfigured generator locations and emissions rates have not been processed using AERMOD yet. It is possible that the maximum concentrations will differ somewhat from those derived with this percent-change-factor method. Ecology's modeler determined this potential difference to e insignificant.

Table 6. Previous (Original) and Revised Facility Boundary TAP Concentrations Data Compared

	December 2010 NOCSD Table 6-7		April 2011 NOCSD Table 6-9		% Change
	$\mu g/m^3$	ICF's description	$\mu g/m^3$	ICF's description	
NO_2, maximum 1-h TWA	791	"Controlled…Max day 8-hr outage"	516	"Max day 24-hr outage"	- 34.8
DEEP, annual TWA	0.0845	"Worst-year, 48-hrs outage"	0.072	"Worst-year, 8-hrs outage"	-14.79

Recalculated concentrations of NO_2 and DEEP at the MIBR, MIRR and MICR were provided by ICF in Figure 6-1 of the "*Second Tier Risk Assessment for Nitrogen Dioxide (NO2) (14-Generator Configuration with NOx controls*) – received April 20, 2011 and figure 7-1 of the "*Second Tier Risk Assessment Diesel Particulate Matter (14-Generator Configuration with 3-Way Catalysts*) - received April 20, 2011. This information is summarized in Table 7.

Table 7. Titan-Attributable Concentration Estimates of Off-Site Average DEEP and Maximum NO_2 Concentrations

	Estimate	**Maximally Impacted**		
		Extra-boundary location ($\mu g/m^3$)	**Commercial building** ($\mu g/m^3$)	**Residence** ($\mu g/m^3$)
DEEP 1-year average	Previous	0.085	0.069	0.007
	Revised	0.073	0.059	0.0061
NO_2 Max 1-hour average	Previous	791	600	356
	Revised	516	495	293

Figure 6 shows the average DEEP concentration gradient attributable to Titan that could occur in the single worst year among five recent years. In their April, 2011 revision to the Second-Tier Assessment for Diesel Particulate Matter, ICF issued forecasts of DEEP that are approximately 14% lower than those estimated in their original forecasts. These revised forecasts are contrasted with the originals forecasts in Table 7. The revised Second-Tier Assessment for Diesel Particulate Matter includes a figure like Figure 6 that shows the revised DEEP concentration gradient along with revised receptor-point concentrations. However, to expedite review, Ecology did not substitute this new figure in place of the older one (Figure 6).

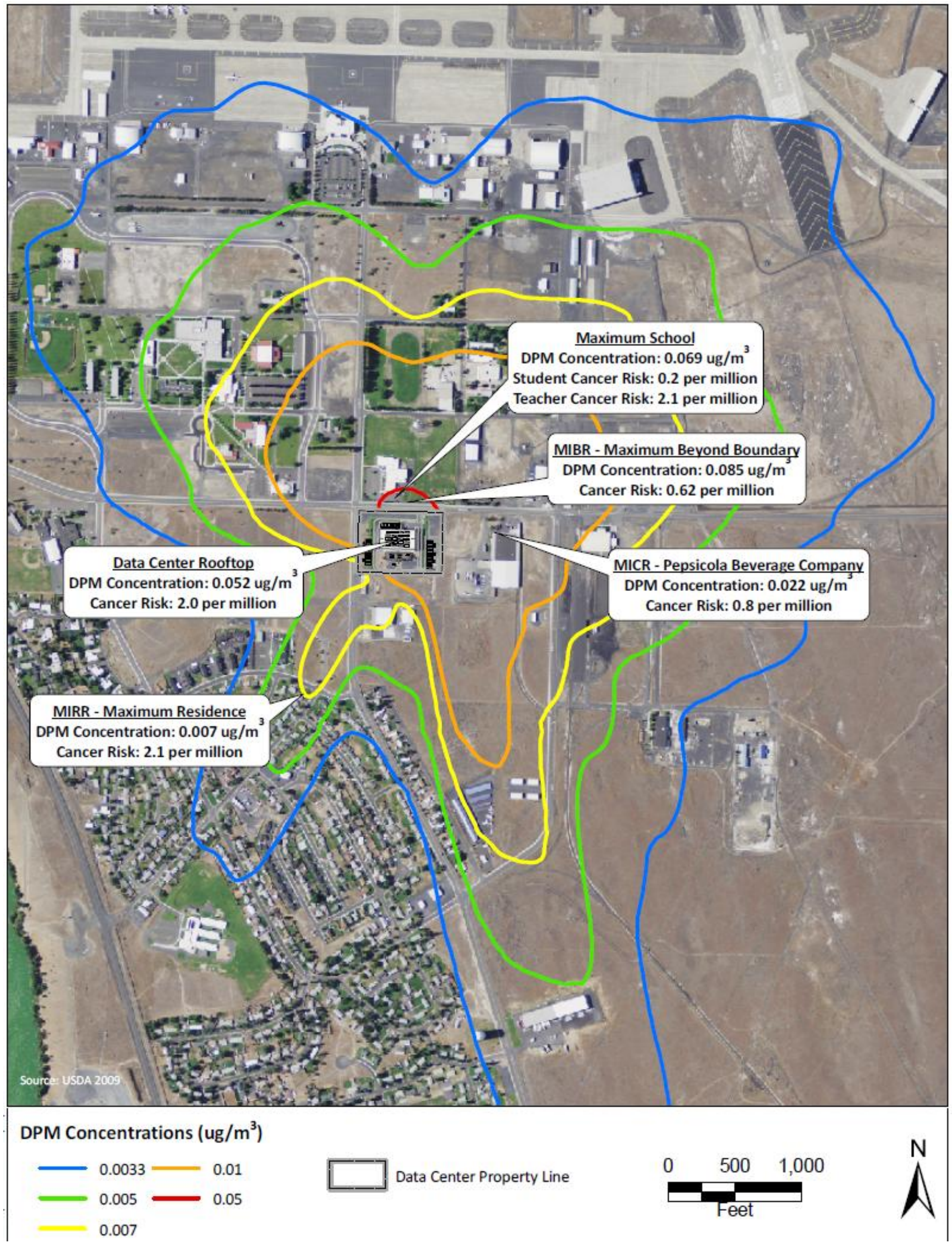

Figure 6. Titan-attributable DEEP 1-year time-weighted average concentration gradient *(Source: ICF)*

Similar to Figure 6, Figure 7 shows the places where the highest 1-hour average NO_2 concentrations attributable to Titan and existing background sources could occur. The red dots indicate concentrations greater than the ASIL of 470 µg/m^3; the green dots indicate concentrations > 441 µg/m^3 (the NO_2 ASIL less the background NO_2 level). Values shown in red font are the revised concentration estimates from ICF given emissions from 14 rather than 16 engines and their enhanced emission controls described in the April 2011 edition of the project proposal.

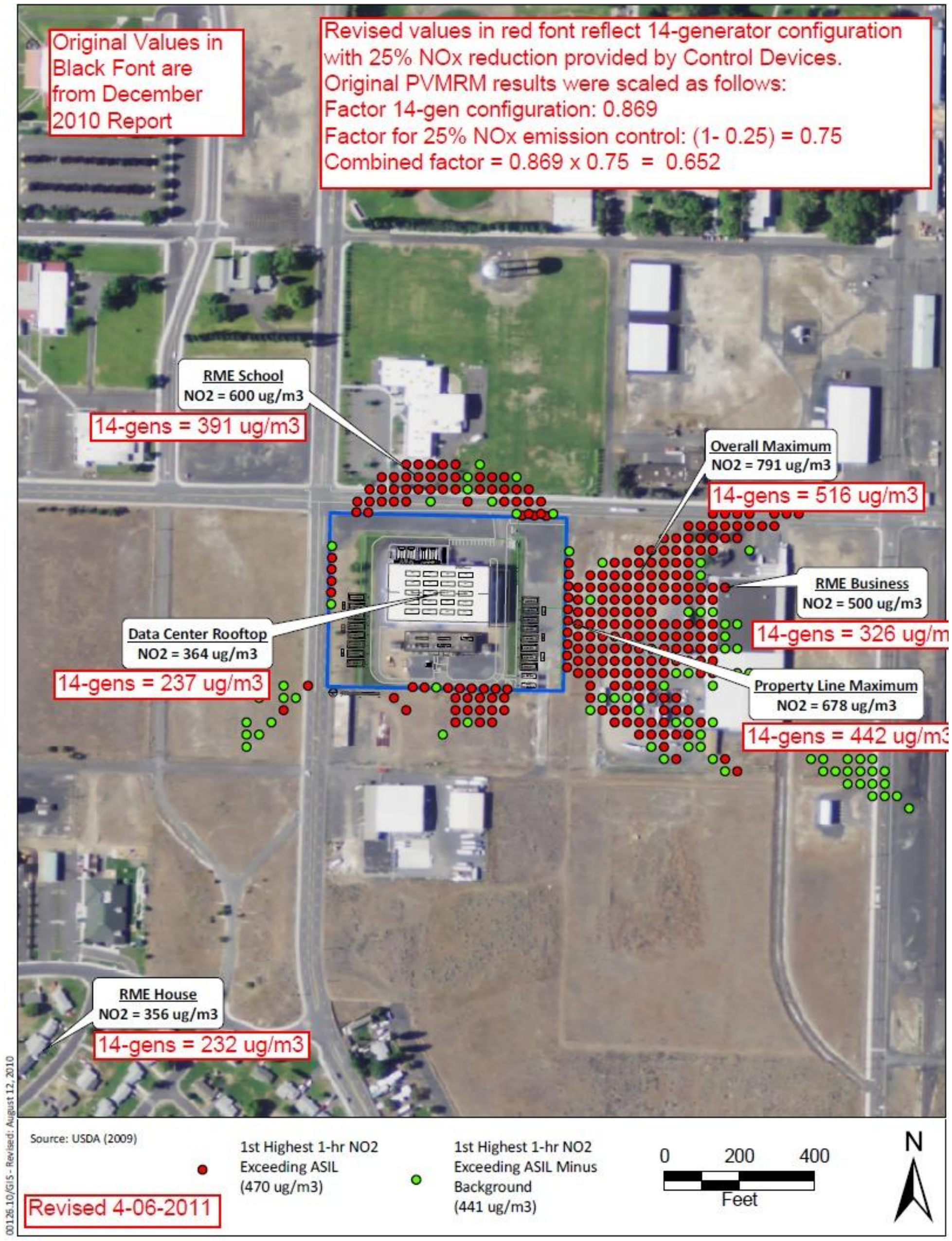

Figure 7. Partially revised Titan-attributable 1-hour time-weighted average NO_2 concentration extremes. *(Source: ICF)*

Figure 8 shows the number of times in the 16-engine simulation that average 1-hour time-weighted average ambient NO_2 concentrations exceed 470-µg/m^3. The frequency analysis uses records of weather data from 2004 and projected emissions that would occur given continuous generator operation throughout 2004. The results of the analysis indicate the south side parking area and entrance to CBSS would have had the most frequent exceedances (71 times) of any area near Titan if the engines had operated continuously throughout 2004. Ecology holds that meteorological data from other years would yield similar results, and that because the project proposed in the April 2011 revision would emit less NO_2 than the project as originally proposed, the recurrence frequency of times when NO_2 concentrations would exceed 470-µg/m^3 is lower.

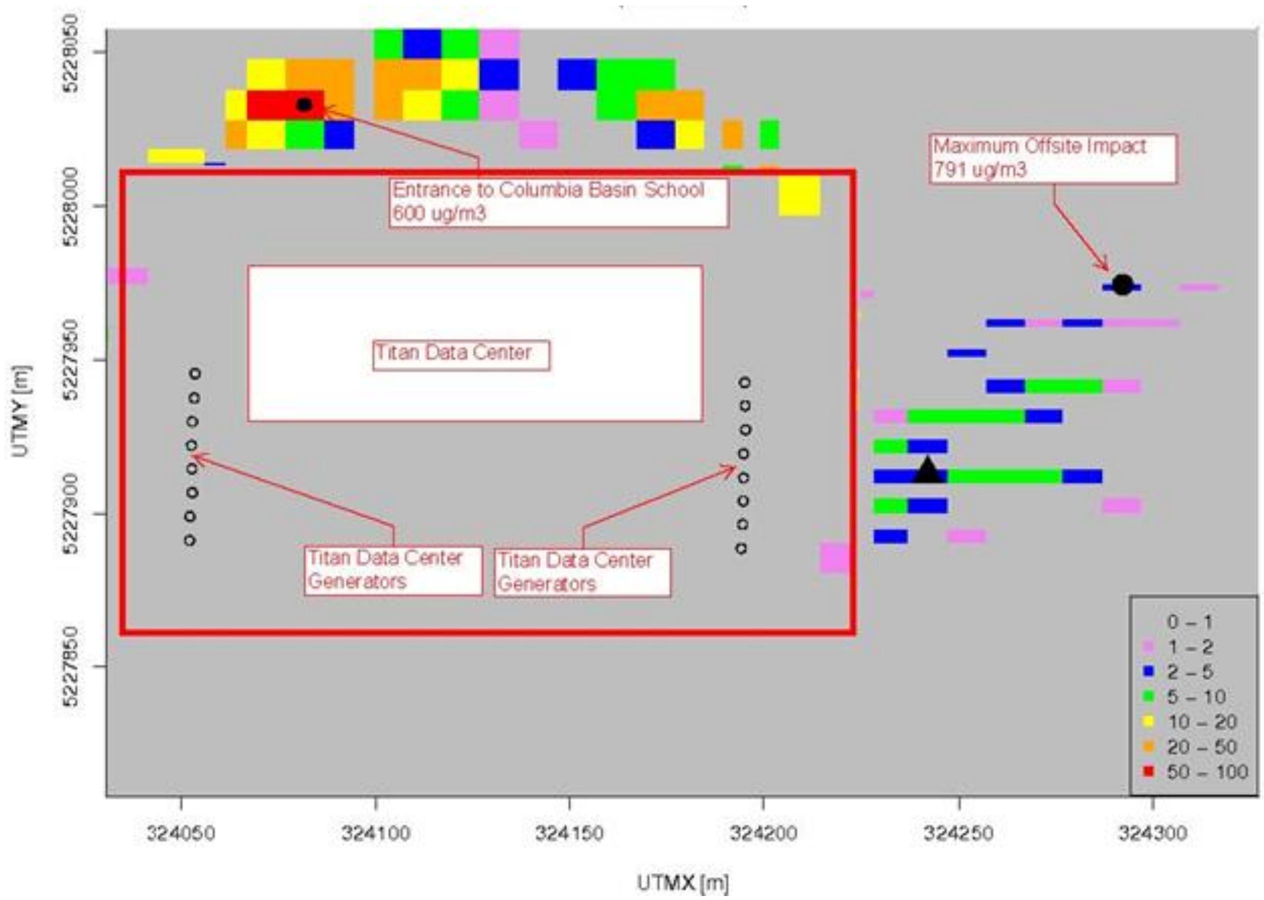

Figure 8. Number of times, given the original project proposal, the Titan-attributable 1-hour time-weighted average NO_2 concentrations would have exceeded 470-µg/m^3 in 2004 if the engines had run continuously. X and Y axes show Universal Transverse Mercator (UTM) coordinates in meters. (*Source: Ecology*)

Figures 9 and 10 show simulated Titan-attributable highest 1-hour NO_2 concentration gradients affecting an area near Titan given the original 16 engine scenario. Because the project proposed in the April 2011 revision would emit less NO_2 than the project as originally proposed, the concentrations of NO_2 are likely to be lower than those shown in these figures.

Figure 9. Simulated Titan-attributable highest 1-hour NO_2 concentration gradient affecting an area east northeast of Titan given the original 16 engine scenario. (*Source: ICF*)

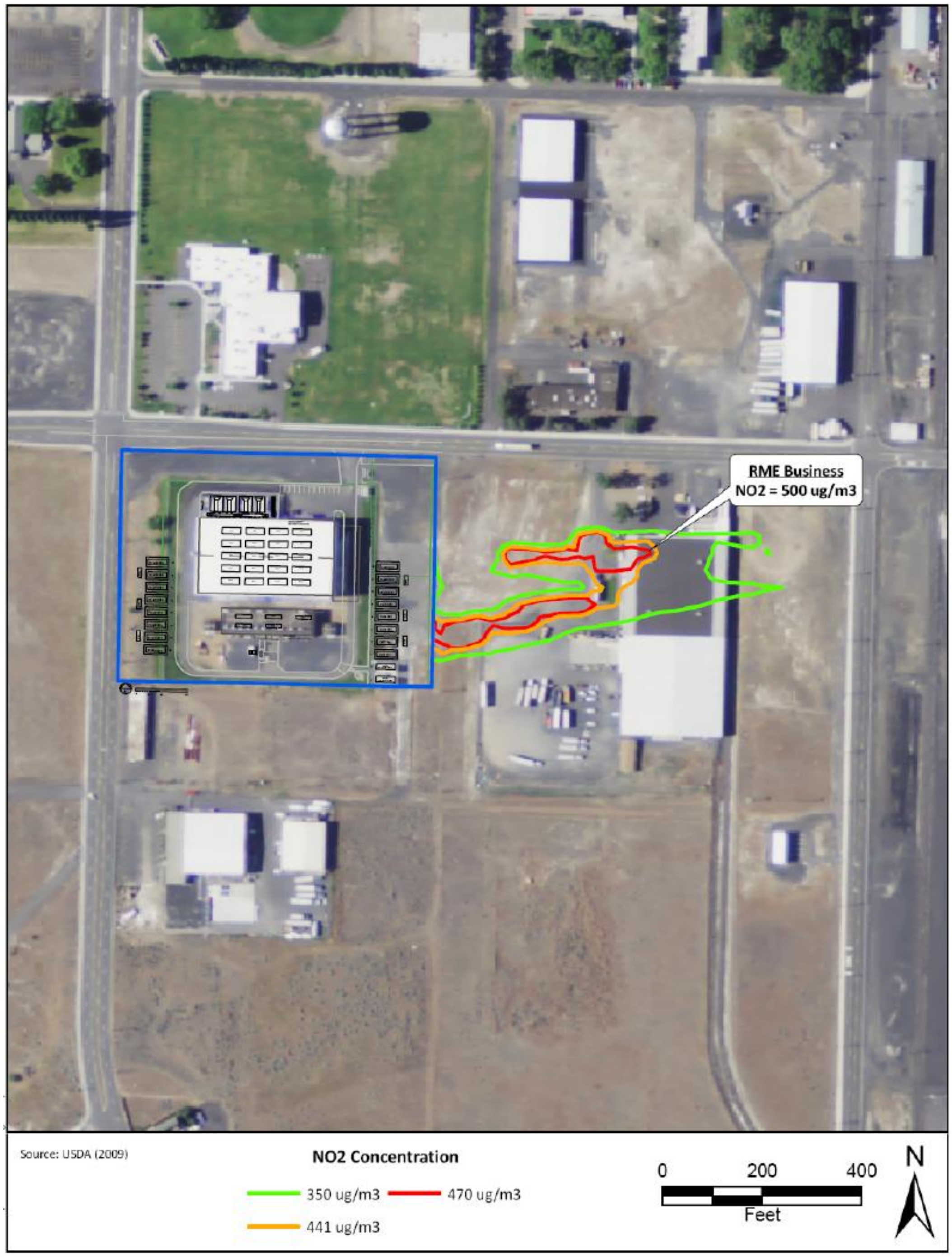

Figure 10. Simulated Titan-attributable highest 1-hour NO_2 concentration affecting a commercial receptor near Titan given the original 16 engine scenario. (*Source: ICF*)

4.6. Pollutants Subject to Second Tier Review

As shown in Table 5, DEEP and NO_2 are subject to second tier review. The air dispersion modeling analysis presented in the Titan permit application predicts that in a one-year averaging period, the off-site or extra-boundary concentration of DEEP would exceed its ASIL, and that in a 1-hour concentration averaging period, maximum off-site concentrations of nitrogen dioxide would exceed its ASIL.

5. HEALTH IMPACTS ASSESSMENT

5.1. Introduction

Information pertaining to potential health impacts of DEEP and NO_2 emitted from Titan's diesel generators was prepared by ICF. The information was reviewed by an Ecology Air Quality Program engineer, toxicologist, and meteorologist. Ecology used the information to prepare an assessment of public health risk associated with exposure to Titan's planned emissions. Ecology's assessment follows the requirements promulgated in Chapter 173-460 WAC. The analysis is not a complete risk assessment, but it follows the four steps of the standard health risk assessment approach proposed by the National Academy of Sciences (NAS 1983, 1994)[7,8]: (1) hazard identification, (2) exposure assessment, (3) dose-response assessment, and (4) risk characterization. The assessment constitutes the basis for the risk manager's permit decision.

5.2. Hazard Identification

The hazard identification step of this risk analysis involves assessing information on potential adverse health effects associated with TAPs that exceed their SQERs (see Table 5). Table 8 summarizes the potential health effects of these TAPs.

Table 8. Potential Adverse Effects of TAPs to be Emitted in Amounts Above SQERs

TAP Emissions That Exceed SQERs	Potential Effects and Hazard Index Targets
Diesel Engine Exhaust Particulates	A range of mild to life-threatening effects has been associated with exposure of various durations and concentrations of DEEP.[9] Exposure to DEEP in controlled laboratory animal studies has demonstrated its carcinogenicity. Epidemiological evidence among occupationally

[7] NAS, 1983, National Academy of Sciences, Risk Assessment in the Federal Government: Managing the Process, National Research Council, National Academy Press, Washington, D.C.
[8] NAS, 1994, National Academy of Sciences, Science and Judgment in Risk Assessment, National Research Council, National Academy Press, Washington, D.C.
[9] Ecology report, "Concerns about Adverse Health Effects of Diesel Engine Emissions," available at http://www.ecy.wa.gov/pubs/0802032.pdf

TAP Emissions That Exceed SQERs	Potential Effects and Hazard Index Targets
	exposed people, although lacking in well quantified exposure levels, suggests diesel exhaust may cause lung and bladder cancer. The International Agency for Research on Cancer (IARC) designated DEEP as a probable (Group 2A) carcinogen in humans based on sufficient evidence in experimental animals and limited evidence in humans (IARC, 1989).[10] In the *Health Assessment Document for Diesel Engine Exhaust*, EPA Office of Research and Development (ORD) states that diesel exhaust is a probable human carcinogen.[11] At exposure levels significantly higher than those that may cause cancer, DEEP can cause a range of other toxic effects including respiratory illnesses, reproductive, developmental, and immune system impairments. Specifically: * eye, nose, and throat irritation along with coughing, labored breathing, chest tightness, and wheezing associated with inflammation and irritation * worsening of allergic reactions to inhaled allergens * increased likelihood of respiratory infections * asthma attacks and worsening of asthma symptoms * decreased lung function * impaired lung growth in children * heart attack and stroke in people with existing heart disease * male infertility * birth defects
Nitrogen dioxide	NO_2 reacts with water in the respiratory tract to form nitric acid, a corrosive irritant. It can react with and damage lung cells, including immune system cells. This damage can affect breathing and may increase the risk of respiratory infections. Brief exposure to NO_2 of less than 1,000 $\mu g/m^3$, such as that experienced near major roadways, or downwind from stationary sources, may cause increased bronchial reactivity in some asthmatics, impaired lung function in people with chronic obstructive pulmonary disease and increased risk of respiratory infections, especially in young children (CalEPA, 2008).[12] Persons with asthma and other pre-existing pulmonary diseases, especially Reactive Airways Dysfunction Syndrome (RADS), may be more sensitive to the effects of NO_2 than the general population. NO_2 probably also increases allergic responses to inhaled pollen. Long-term exposure to NO_2 can lead to chronic respiratory

[10] International Agency for Research on Cancer, 1989, Diesel and Gasoline Engine Exhausts and some Nitroarenes, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Vol 46, World Health Organization, Lyon, France

[11] "Health Assessment Document for Diesel Engine Exhaust," U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington, D.C., EPA/600/8-90/057F, 2002, available at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060.

[12] http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD2_final.pdf#page=209, accessed on October 27, 2010

TAP Emissions That Exceed SQERs	Potential Effects and Hazard Index Targets
	illness such as bronchitis and increase the frequency of respiratory infections.
Acrolein	Acrolein is a strong eye and respiratory tract irritant. Exposure by inhalation can alter breathing patterns by narrowing airway openings (airway constriction), and can damage cells lining the airways, prompting white blood cells to enter the lungs (CalEPA, 2008).[13]
Benzene	At high exposure levels, adverse effects would involve multiple organs and biological processes. The acute hazard index targets are reproductive and developmental organs, immune system, hematologic system; chronic hazard index targets are hematopoietic system, development, nervous system. In addition, benzene is a known human carcinogen.
Carbon Monoxide	High exposure levels affect blood oxygenation and the cardiovascular system.

5.2.1. DEEP and NO_2

Emissions of DEEP and NO_2 are subject to second tier review based on their critical effects, cancer, and acute respiratory impairment, respectively. In addition to evaluating cancer risk, the potential for DEEP to cause acute respiratory tract impairment is evaluated in subsequent analysis with additional effects from nitrogen dioxide and acrolein, which may also cause acute respiratory tract impairment. NO_2 and acrolein are not known to be carcinogenic.

5.2.2. Acrolein

As shown in Table 5, the estimated maximum possible extra-boundary acrolein concentration attributable to Titan is likely to be less than 0.0073 μg/m^3.[14] Acrolein exposure can cause eye and upper respiratory tract irritation at low exposure levels. DEEP is an aerosol, and since, like NO_2, acrolein is a gas at ambient temperatures, its effects are not likely included as part of the DEEP risk assessments on which the chronic reference exposure level (CREL) and reference concentration (RfC) are based. Ecology therefore included acrolein in the current health impact analysis. As noted in Table 5, Titan-attributable acrolein concentrations are likely to be less than 0.5% of the ASIL. Also, acrolein concentrations are likely to be less than 0.3% of the AREL (2.5 μg/m^3, 1-hour TWA). Acrolein will increase the upper airway irritation hazard index of DEEP and NO_2 by less than 0.3 percent. Because ICF did not provide detailed estimates of acrolein concentrations that could occur at receptors near Titan, Ecology added 0.3% to the DEEP and NO_2 hazard index in the subsequent analysis.

[13] http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD1_final.pdf#page=42, accessed on October 27, 2010
[14] Because the project proposed in the April 2011 revision would have fewer engines and more efficient emission controls than in the project as originally proposed, the resulting acrolein concentrations are likely to be lower than 0.0073 μg/m^3.

5.2.3. Benzene

As shown in Table 5, the estimated maximum annual average benzene concentration beyond the Titan property boundary is 0.00152-µg/m^3, which is less than the ASIL. Given average air pollutant dispersion conditions, a 1-hour time weighted average concentration of 19-µg/m^3 could be expected over a 48-hour interval[15] when the generators are operated in an emergency. Sixty-eight percent of annual benzene emissions are expected to occur in such intervals. A concentration of 19-µg/m^3 is less than the OEHHA chronic inhalation reference exposure level (60-µg/m^3, long-term average concentration) and less than 1.5% of the acute inhalation reference exposure level (1300-µg/m^3, 1-hour TWA).[16] Even if unplanned outage generator operation occurred during a 48-hour interval in which worst case dispersion conditions persisted, it is unlikely the benzene concentration would exceed the inhalation reference exposure levels at that time. This indicates adverse non-cancer health risks attributable to benzene emissions from Titan are unlikely to occur.

Benzene is a known human carcinogen. OEHHA published an inhalation cancer unit risk factor of 0.000029 $(\mu g/m^3)^{-1}$.[17] If a house was built and then occupied by residents for 70 years at the location where the maximum annual average benzene concentration (0.00152-µg/m^3) may occur, the additional cancer risk could be up to 4.4E-8 (44 in a billion), which is nearly 23-fold less than 1.0E-6 (one in a million).

Given the lack of non-cancer health effects risks and minimal additional cancer risk posed by Titan-attributable benzene emissions, Ecology did not evaluate benzene further.

5.2.4. Carbon Monoxide

As shown in Table 5, the estimated maximum possible extra-boundary carbon monoxide concentration attributable to Titan is 2958.667-µg/m^3, 1-hour time weighted average concentration, which is ~13% of its acute reference exposure level (AREL) 23,000-µg/m^3 1-hour time weighted average concentration.[18] Given the low CO concentration likely to result from Titan emissions, even under worst-case air pollutant dispersion conditions, and given that the effects of CO at higher exposures are on the cardiovascular system, Ecology did not evaluate CO further. Given Titan's revised proposal to use fewer generators than originally proposed and to limit their new engines to 8 rather than 48 hours per year for unplanned power outages, CO emissions are expected to be even lower.

[15] Titan originally proposed to operate their new engines for up to 48 hours per year for unplanned power outages; however, Titan's latest proposal is for no more than 8 hours per year of operation for unplanned power outages. Ecology did not update modeled concentrations discussed in this subsection based on the revised proposal because the new modeled maximum concentrations are lower.

[16] See Section 5.4.1 for descriptions of inhalation reference exposure levels.

[17] http://www.oehha.ca.gov/air/hot_spots/tsd052909.html, accessed on October 27, 2010

[18] http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD2_final.pdf#page=41, accessed on October 27, 2010

5.2.5. Environmental Fate

The World Health Organization International Programme on Chemical Safety report – Diesel Fuel and Exhaust Emissions[19] cites information on the topics of environmental transport, distribution, and transformation of diesel exhaust:

> *"The compartment first affected by diesel exhaust emissions is the atmosphere. The hydrosphere and geosphere are contaminated indirectly by dry and wet deposition. The environmental fate of the individual constituents of diesel exhaust is generally well known: Particles behave like (non-reacting) gas molecules with regard to their mechanical transport in the atmosphere; they may be transported over long distances and even penetrate the stratosphere. The overall removal rate of diesel particles is estimated to be low, resulting in an atmospheric lifetime of several days. During aging, particles may coagulate, with higher fall-out rates, thus reducing the total airborne level. The elemental carbon of diesel particulates may act as a catalyst in the formation of sulfuric acid by oxidation of sulfuric dioxide. The organic components adsorbed on elemental carbon may undergo a number of physical and chemical reactions with other atmospheric compounds and during exposure to sunlight."…*
>
> *"The major fraction (50-80%) of the particulate emissions of diesel engines is in the submicron size, ranging from 0.02 to 0.5 µm ... Once particles have been emitted, their mechanical transport in the atmosphere is like that of gas molecules (nonreactive). Together with carbon particles from other combustion processes, they may be transported over long distances and even penetrate the stratosphere (Muhlbaier Dasch & Cadle, 1989)…*
>
> *"The hydrosphere and geosphere may be affected indirectly by diesel exhaust emissions after dry or wet deposition of particulate matter or individual constituents."*[11]
>
> *"Atmospheric removal of airborne carbon particles consists mainly of dry deposition and scavenging by precipitation (wet deposition). The rate of wet removal is directly correlated to the ratio of organic to elemental carbon and is low for small ratios (Muhlbaier Dasch & Cadle, 1989).*[20] *As the overall removal rate of diesel particulates is estimated to be low, the atmospheric life-time is several days (Jaenicke, 1986)."*

The wide range of chemical constituents in diesel engine exhaust has an even wider range of atmospheric fates. Diesel exhaust's constituents can react with atmospheric radicals to form new species, combine with other substances to form more complex species, and be deposited onto surfaces.

[19] United Nations Environment Programme, International Labour Organisation, World Health Organization, International Programme on Chemical Safety, "Environmental Health Criteria 171, Diesel Fuel and Exhaust Emissions," World Health Organization, Geneva, 1996, http://www.inchem.org/documents/ehc/ehc/ehc171.htm, accessed December 3, 2008.
[20] Muhlbaier Dasch J & Cadle SH, 1989, Atmospheric carbon particle in the Detroit urban area: Wintertime sources and sinks, Aerosol Sci Technol, 10: 236-248 (as cited in 11).

The two most important processes affecting diesel exhaust particles in the atmosphere are: (1) dry and wet deposition (physical removal) of the particles, and (2) atmospheric transformations of species adsorbed to the particles.[21] A particle's atmospheric lifetime due to dry deposition is a function of its diameter.[22] Diesel exhaust particles, generally smaller than 1-µm,[23] are expected to remain in the atmosphere from 5 to 15 days. Rain results in almost complete wash-out of particles 0.1 to 10 µm in diameter from the atmosphere.[24,25,26] Thus some of the DEEP will deposit on the surfaces of objects, soils, *et cetera*, near Titan.

Organic chemicals, notably PAH derivatives, in the particles in the exhaust stream may be protected from photolysis and/or chemical reactions. Organic chemicals coating the surface of the particles are expected to primarily react with sunlight (through photolysis), ozone (O_3), gaseous nitric acid (HNO_3), and nitrogen dioxide (NO_2). Organic chemicals coating the surface of the particles also volatilize from the particle and become more susceptible to photolysis and chemical reactions. Five or more ringed PAHs and nitro-PAHs have low volatility and tend to remain bound to larger particles.[27] The 5+ ringed PAHs and PAH derivatives tend to be carcinogenic, whereas ones with fewer aromatic rings are not likely to be carcinogenic.

A literature search did not yield information about the fate of DEEP deposited in terrestrial and aquatic environmental compartments.

5.3. Exposure Assessment

In order for pollutants to cause harm, people must be exposed. The exposure assessment step of the HIA involves measuring or estimating concentrations, durations, and frequencies of exposures to agents present in the environment, and the estimation of hypothetical exposures that might arise from the release of TAPs into the air outside of space controlled by the permit applicant. To the practical extent possible, the current exposure assessment characterizes past, current, and expected TAP exposures. Ambient air is publicly accessible air in the vicinity of a proposed project. Inhalation will be the dominant exposure route of humans to Titan's diesel exhaust particulate and gaseous emissions. Small exposures via ingestion and skin contact will also occur.

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[21] http://www.arb.ca.gov/toxics/dieseltac/part_a.pdf
[22] Graedel, T. E. and C. J. Weschler, 1981, Chemistry within aqueous atmospheric aerosols and Raindrops, *J. Geophys Res*., 19, 505-539.
[23] Pierson W.R., Gorse R.A., Jr., Szkariate A.C., Brachaczek W.W., Japar S.M., Lee F.S.C., Zweidinger R.B. and L.D. Claxton, 1983. Mutagenicity and chemical characteristics of carbonaceous particulate matter from vehicles on the road. Environ. Sci. Technol., 17, 31-44
[24] Leuenberger, C., Ligocki, M. P., and J. F. Pankow, 1985. Trace organic compounds in rain. 4. Identities, concentrations and scavenging mechanisms for phenols in urban air and rain. Environ. Sci. Technol., 19, 1053-1058.
[25] Ligocki M. P., Leuenberger C., and J.F. Pankow, 1985a. Trace organic compounds in rain - III. Particle scavenging of neutral organic compounds. *Atmos. Environ*., 19, 1619-1626.
[26] Ligocki M.P., Leuenberger C., and J.F. Pankow, 1985b. Trace organic compounds in rain - II. Gas scavenging of neutral organic compounds. *Atmos. Environ*., 19, 1609-1617
[27] http://www.arb.ca.gov/toxics/dieseltac/part_a.pdf

5.3.1. Multi-Route Exposures

The following paragraph and table is from the California OEHHA's *Air Toxics Hotspots Risk Assessment Guidance*.[28]

> *"Table [9] shows the multipathway substances that, based on available scientific data, can be considered for each non-inhalation exposure pathway. The exposure pathways that are evaluated for a substance depend on two factors: 1) whether the substance is considered a multipathway substance for the Hot Spots Program (Table 5.1), and 2) what the site-specific conditions are. A multipathway substance may be excluded from a particular exposure pathway because its physical-chemical properties can preclude significant exposure via the pathway. For example, some water-soluble chemicals do not appreciably bioaccumulate in fish; therefore, the fish pathway is not appropriate. In addition, if a particular exposure pathway is not impacted by the facility or is not present at the receptor site, then the pathway is not evaluated. For example, if surface waters are not impacted by the facility, or the water source is impacted but never used for drinking water, then the drinking water pathway is not evaluated."*

Table 9. Specific Pathways to be Analyzed for Each Multi-Pathway Substance

Substance	Ingestion Pathway									
	Soil	**Dermal**	**Meat, Milk & Eggs**	**Fish**	**Exposed Vegetable**	**Leafy Vegetable**	**Protected Vegetable**	**Root Vegetable**	**Water**	**Breast Milk**
4,4'-Methylene dianiline	X	X		X	X	X	X	X	X	
Creosotes	X	X	X	X	X	X			X	
Diethylhexylphthalate	X	X		X	X	X	X	X	X	
Hexachlorocyclohexanes	X	X		X	X	X			X	
PAHs	X	X	X	X	X	X			X	
PCBs	X	X	X	X	X	X	X	X	X	X
Cadmium & compounds	X	X	X	X	X	X	X	X	X	
Chromium VI & compounds	X	X	X	X	X	X	X	X	X	
Inorganic arsenic & compounds	X	X	X	X	X	X	X	X	X	
Beryllium & compounds	X	X	X	X	X	X	X	X	X	
Lead & compounds	X	X	X	X	X	X	X	X	X	
Mercury & compounds	X	X		X	X	X	X	X	X	
Nickel	X	X	X		X	X	X	X	X	
Fluorides (including hydrogen fluoride)	To be determined									
Dioxins & furans	X	X	X	X	X	X	X		X	X

[28] The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, August 2003.

It is possible that levels of PAHs and the few other persistent chemicals in DEEP will build up in food crops, soil, and drinking water sources near Titan; however, quantifying exposure to these chemicals from these media is impractical and very unlikely to yield significant concerns. Inhalation is the only route of exposure to DEEP that has received sufficient scientific study to be useful in human health risk assessment. The only significant route of exposure to airborne nitrogen dioxide and acrolein is inhalation.

5.3.2. Identification of Exposed Populations

To assess exposure to TAPs and ultimately estimate potential health risks to people exposed to Titan diesel engine emissions, ICF identified key locations where people might be exposed, including some of the buildings near the data center. ICF did not identify all the buildings on lots adjacent to Titan's property. Notably, ICF did not identify the building to the NE of Titan on Randolph Road NE. To find this information, Ecology queried Grant County records (Figure 10). Records indicate parcel 171050000, 401050000 is owned by CENEX Supply & Marketing Inc. However, Ecology could not determine how the building on this lot is used due to lack of information. The yellow area in Figure 11 is the Titan parcel.

ICF did not identify all buildings near Titan where sensitive populations are likely to be concentrated. To find this information, Ecology queried Google Maps and bing.com maps and found several public access buildings, including three schools near Titan:

- Columbia Basin Secondary School, 6527 Patton Blvd. NE (≈300 feet from the nearest generators). This school has the highest Titan impact. It currently has 223 students enrolled in grades 6 through 12.

- Big Bend Community College, 7662 Chanute Street NE (≈ 700 feet from the nearest generators). This is an undergraduate education facility offering Associate's degrees. It has an enrollment of approximately 2000 of which approximately 2/3 attend full-time. Up to 160 students live on campus.

- Family Services Head Start, 1402 E. Craig Street (≈800 feet from the nearest generators). This building houses seven head start classrooms, family planning services, and the administrative offices for Family Services of Grant County.

Ecology did not find any hospitals or doctor offices near Titan. However, we found a physical therapy clinic about 2000 feet to the west of Titan, and we found two assisted living facilities to the south. The closest of these is Twila's Adult Family Home, 8952 Tinker Loop #A-B. It is approximately 5000 feet south of Titan. There is also a Boys and Girls Club of America about 2400 feet to the west of Titan.

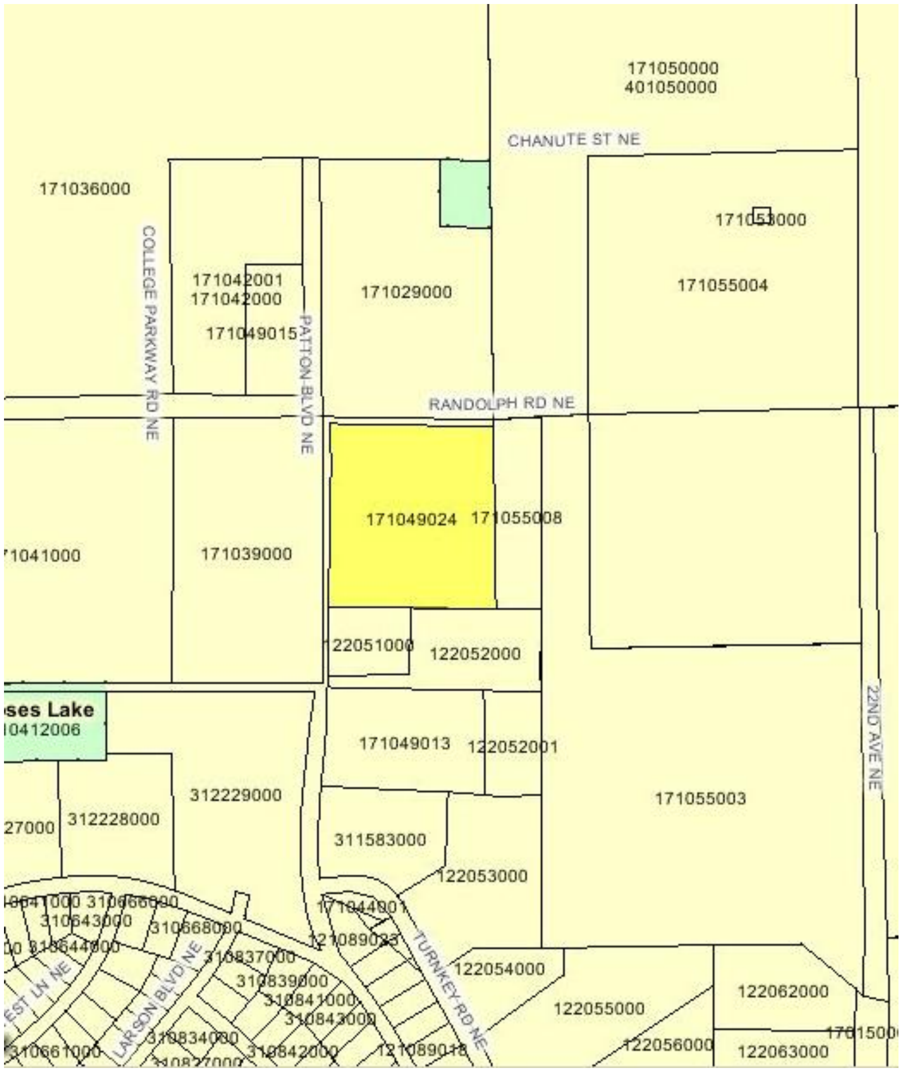

Figure 11. Property parcels near Titan.

(*Source: Grant County maps http://gismapserver.co.grant.wa.us/)*

5.3.3. Demographic Estimates

The Titan Data Center is in U.S. Census Bureau Tract 9808, block group 1, of Grant County[29] (Figure 12). In 2000, tract 9808 had 4232 persons residing in 1278 housing units (about three per unit). The U.S. Census Bureau reported year 2000 demographic profile highlights of Moses Lake North as cited in Table 10 along with characteristics of the entire U.S. for comparison.

[29] http://www.ofm.wa.gov/pop/smallarea/maps/bg2000/pdf/northcentralbg.pdf

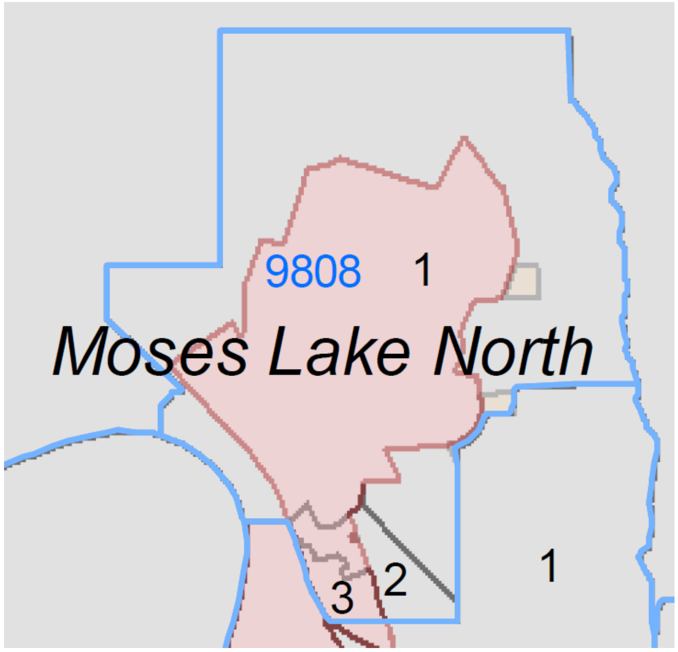

Figure 12. North Moses Lake census tract and vicinity map.

(*Source*: *http://www.ofm.wa.gov/pop/smallarea/maps/bg2000/pdf/northcentralbg.pdf. Accessed 10-26-2010*)

Table 10. Moses Lake North Demographic Profile Highlights

	Moses Lake North (%)	US (%)
Male	50.4	49.1
Female	49.6	50.9
Median age (years)	35.3	21.6
Under 5 years	11.2	6.8
18 years and over	59.5	74.3
65 years and over	5.2	12.4

(Source: http://factfinder.census.gov/servlet/SAFFFacts?_event=Search&geo_id=&_geoContext=&_street=&_county=moses+lake+north&_cityTown=moses+lake+north&_state=04000US53&_zip=&_lang=en&_sse=on&pctxt=fph&pgsl=010&show_2003_tab=&redirect=Y, accessed August 20, 2010*)*

In consideration of the possibility that new buildings will be constructed and occupied in the DEEP and NO_2 affected area near Titan, Ecology examined current land-use zoning. The area within the 1.0E-6 additional cancer risk isopleth of Titan's DEEP emissions is zoned for a range of uses including Grant County International Airport, public utilities, commercial, residential, and industrial. The zoning boundaries are illustrated in the Grant County zoning map (Figure 13).

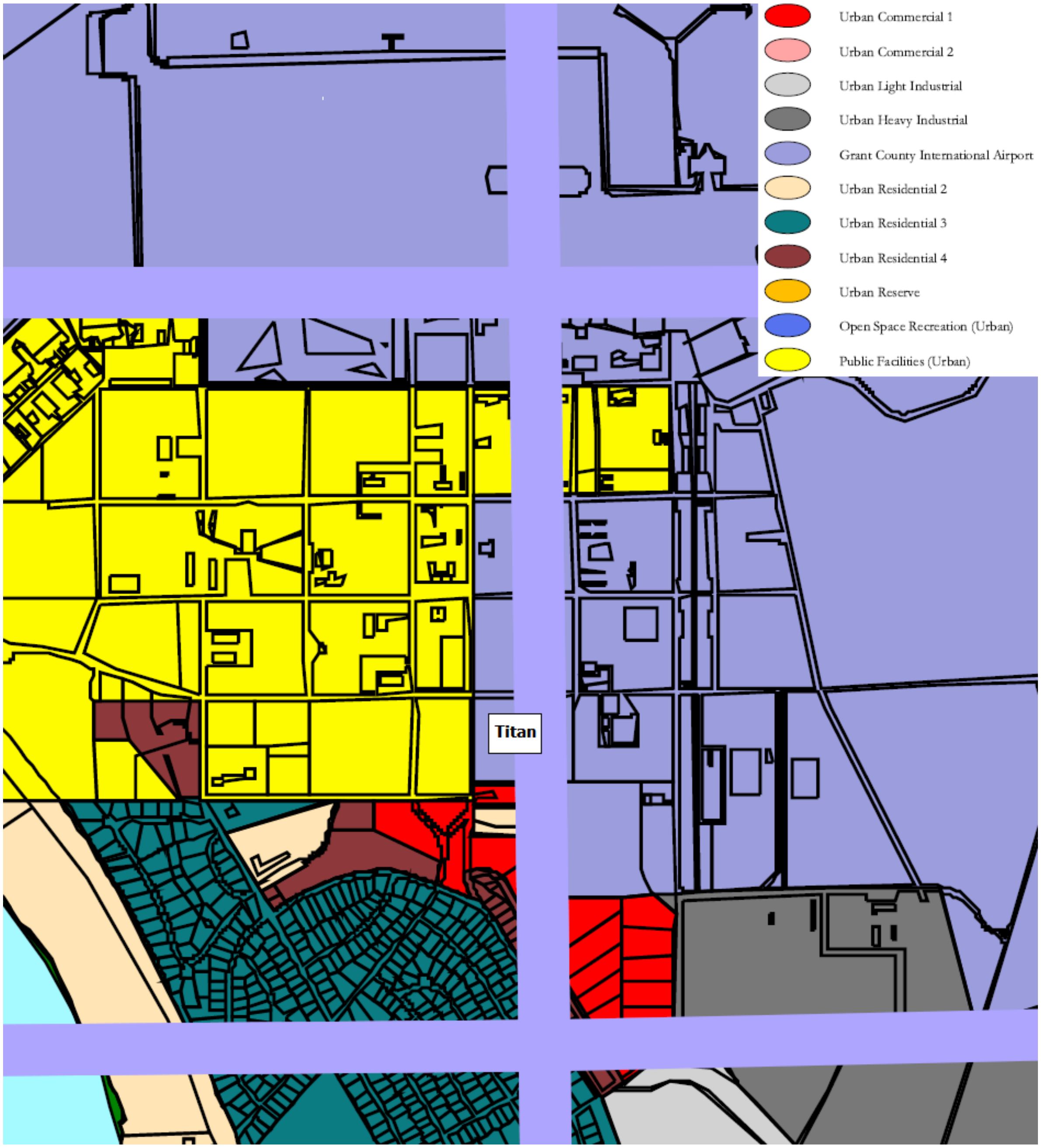

Figure 13. Section of Grant County land use zoning map.
(Source: http://gismapserver.co.grant.wa.us/documents/zonemap.pdf)

Based on these zonings, it is likely that area near the data center will be further developed. The affected area is currently occupied by multiple residences, schools, businesses and factories. Current and future land use of this area is significant to potential impacts of Titan's emissions on human health.

ICF identified some of the buildings in the area nearest the data center. These are shown in Figure 3. Among these buildings, the maximally impacted residential receptors (MIRR) and maximally impacted commercial receptors (MICR) would experience highest average DEEP and NO_2 concentrations according to AERMOD results. ICF also identified outdoor locations, beyond the access controlled by Titan where simulated DEEP 1-year average and NO_2 1-hour average concentration maxima occur (the maximally impacted extra-boundary receptors, MIBR). The MIRR, MICR, and MIBRs attributable to the data center's DEEP and NO_2 emissions are noted in Table 11.

Table 11. Titan-Attributable DEEP and NO_2 Maximally Exposed Receptor Locations

	DEEP[30]	NO_2[31]
MIRR	A residence at 1003 Larson Blvd.[32]	A residence at 1139 Larson Blvd.[33]
MICR	Columbia Basin Secondary School	Columbia Basin Secondary School
MIBR	An open air point in the Columbia Basin Secondary School playground 20 meters north of the Titan boundary	An open air point about half way between Titan and PepsiCo

5.3.4. Estimates of Exposure Durations of Identified Populations

Cancer risk from exposure to DEEP is estimated by determining the DEEP concentration at each receptor point. These concentrations are multiplied by the DEEP unit risk factor (URF). Because URFs are based on a continuous exposure over a 70-year lifetime, exposure duration and exposure frequency are considered.

People who work at commercial locations near Titan are likely only to be exposed for up to the duration of their workday (e.g., eight hours per day). Residents living near the data center have the potential to be exposed for a longer period (e.g., 24 hours per day). A person who lived at a MIRR, worked at the MICR, and was frequently at the MIBR location would have the highest conceivable exposures.

In order to estimate the exposure times of various populations to the TAPs of concern, standard values were used. These values are estimates of how much time people using the MIBR, MICR,

[30] ICF *Second-Tier Risk Assessment for Diesel Particulate Matter: Titan Data Center, Moses Lake, WA,* August 2010, Figure 7-1, and subsequent e-mails from ICF.
[31] ICF *Second-Tier Risk Assessment for Nitrogen Dioxide (NO_2): Titan Data Center, Moses Lake, WA,* August 2010, Figure 6-1.
[32] The Titan-attributable DEEP MIRR is a house located at 1003 Larson Blvd. The Grant County Assessor lists the current owners of this property as William H and Barbara A Geiger.
[33] The Titan-attributable NO_2 MIRR is a house located at 1139 Larson Blvd. The Grant County Assessor lists the current owner of this property as the Housing Authority of Grant Co.

MIRR, and Columbia Basin Secondary School (as students) might be in those locations. In this assessment:

- A continuous exposure 24 hr/day for 365 days/yr for 70 years is assumed for people in the MIRR.
- Repeated exposures of 8 hr/day for 250 days/yr for 40 years are assumed for people in the MICR.
- Repeated exposures of 2 hr/day for 250 days/yr for 30 years are assumed for people in the MIBR.
- Columbia Basin Secondary School student body has an on-time graduation rate of 22.9% and an extended graduation rate of 43.7% (2008-2009). The annual dropout rate is 24.3% (2008-2009).[34] From these statistics, it's apparent that though many students drop out, over 20% extend matriculation and thereby graduate late. The school enrolls grades 6 through 12, thus it is reasonable to assume that some students may be enrolled for eight or more years. The school's 2010-2011 calendar indicates classes are held on about 185 days, typically from 8:00 a.m. to 2:55 p.m. Assuming this year is typical, in all, some students may spend a total of 1.35 years at the school: 1.35 yr = 8 yr x (185 days / 365 days/yr) x (8 hr / 24 hr/day).

5.3.5. TAP Concentration Estimates

To assess human exposure to DEEP and NO_2 attributable to the data center's diesel engine generators, ICF used AERMOD to calculate average annual concentrations and 1-hour TWA maximum concentrations, respectively, in breathing zone air at each of the grid points shown in Figure 5. The model used emissions rate estimates combined with recent meteorological data. The results are estimates of DEEP and NO_2 concentrations at grid points outside the Titan facility property boundary. ICF examined the estimates of concentrations at grid points to locate the points of highest concentrations. Ecology gathered these estimates into Table 5 from figures and tables in documents and e-mails submitted by ICF.

Ecology verified that the DEEP and NO_2 concentrations at the maximally impacted extra-boundary, commercial building, and residential receptor locations reported by ICF were correct and that the given locations of these receptors agree with AERMOD results. Among these, the highest simulated DEEP 1-year TWA concentration is at an open air point in the Columbia Basin Secondary School playground 20 meters north of the north side of Titan's property boundary. The highest simulated NO_2 1-hour TWA concentration is at an open air point about 200 feet east of Titan's east side property boundary.

In accordance with WAC 173-460-090(5), Ecology considered background concentrations of DEEP and NO_2 as part of this second tier review. Existing levels of these pollutants near the Titan facility result from emissions by motor vehicles and other diesel engine equipment

[34] http://reportcard.ospi.k12.wa.us/summary.aspx?schoolId=3385&OrgType=4&reportLevel=School&year=2007-08, accessed October 28, 2010

including the Ask.com generators already located at the Titan facility. NO_2 is also emitted from other points of high temperature combustion. Such sources are ostensibly included in the latest estimates of DEEP and NO_2 concentrations in the EPA's National-Scale Air Toxics Assessment (NATA) and other available data on ambient concentrations. To consider background concentrations, Ecology used the NATA DEEP concentrations estimates for the census tract in which the Titan Data Center is located, and Ecology's estimate of NO_2 background in the Moses Lake area, as further discussed below.

5.3.5.1. Existing Background Levels

Ecology considered "background" DEEP, NO_2, and acrolein concentrations in the current review. WAC 173-460-090 second tier review part 5 states:

> *"(5) Background concentrations of TAPs will be considered as part of a second tier review. Background concentrations can be estimated using: (a) The latest National Ambient Toxics Assessment data for the appropriate census tracts; or (b) Ambient monitoring data for the project's location; or (c) Modeling of emissions of the TAPs subject to second tier review from all stationary sources within 1.5 kilometers of the source location."*

DEEP, NO_2, and acrolein are released into the atmosphere by various human activities. Titan emissions will add to the existing levels. Knowledge of currently existing levels is needed for predicting how much exposure there will be from both existing and proposed emissions. Quantities of DEEP, NO_2, and acrolein in ambient air can be measured by sampling and laboratory analyses (monitoring) or calculated by using information on process rates, emissions factors (emissions inventories), and meteorological conditions.

Ecology is unaware of any DEEP, NO_2, or acrolein monitoring anywhere in Grant County. In the absence of monitoring data, the median concentrations reported in recent NATA reports are the only available estimates of DEEP and acrolein in the Titan area.

NO_2 is not measured near Titan, but Ecology estimates the regional "background" concentration is 29 $\mu g/m^3$. The gridded 1-hour average NO_2 concentration was computed using the model-observation fusion available in EPA's BenMAP program. The predicted NO_2 concentration from the operational AIRPACT runs was combined with observations from NO_2 monitors in Washington and northern Oregon to produce the estimates of the 98th percentile concentrations.

The NATA contains calculated concentrations of DEEP and 177 Federal Clean Air Act-listed Hazardous Air Pollutants (but not NO_2) in most U.S. census tracts. NATA contains estimates for the census tract where the data center is now located (tract 9808, Moses Lake North, Grant County) and other census tracts. The estimates were derived with emissions inventory information and EPA's Assessment System for Population Exposure Nationwide (ASPEN) model.[35] The estimates are aggregates of pollutant concentrations resulting from emissions from various source categories such as road vehicles and equipment, and vehicles used for nonroad purposes. These are shown in Table 12.

Table 12. NATA DEEP and NO_2 Concentration Estimates for Census Tract 9808 in Grant County, Washington

		NATA Year	
		2005	**2002**
DEEP	Onroad	N/A	0.006479306
	Nonroad	N/A	0.025366558
	Total	N/A	0.031845864038848
	Onroad exposure	N/A	0.005000041
	Nonroad exposure	N/A	0.012227836
	Total exposure	N/A	0.017227876914059
Acrolein	Nonpoint	0.001359571	0.00164
	Onroad	0.000211545	0.00689
	Nonroad	0.00107999	0.00142
	Background	0.00710554	0
	Total	0.009756645	0.01
	Nonpoint Exposure	0.001269751	0.00153
	Onroad Exposure	0.000278925	0.00889
	Nonroad Exposure	0.00081413	0.0011
	Background Exposure	0.00710554	0
	Total Exposure	0.009468346	0.01157

N/A: Estimate Not Available
Concentration estimates are $\mu g/m^3$

The Ask.com data center was constructed after 2005. Therefore, DEEP and acrolein originating from its existing generators were not included in any NATA estimate. ICF did not model Ask.com's emissions. Therefore, Titan's emission impacts were increased by $2/16^{th}$, which accounts for the additional emissions of two remaining Ask.com engines in addition to the 16 originally proposed in the Titan project. Ecology did not recalculate the emissions attributable to Ask.com based on the revised proposal since doing so would have increased estimates based on this calculation by only 1.8%, which is more than offset by the elimination of the two larger engines from the original Titan proposal.

The facility-attributable TAP emission impacts were added to the most recent NATA estimate for the affected census tract in order to estimate the overall concentrations of DEEP that could exist at each receptor after Titan's generators begin operating. These estimates, along with

[35] ASPEN is the computer simulation model used to estimate toxic air pollutant concentrations for NATA. For details, see http://www.epa.gov/ttn/atw/nata/aspen.html.

Titan's percentages of total DEEP concentrations that could exist at off-site receptor locations following completion of the project, are shown in Table 13.

Table 13. Maximum Off-Site 1-Year Average DEEP, 1-Hour NO_2, and 24-Hour Acrolein Concentrations Attributable to Titan and Other Sources Given the Original Project Proposal

	Titan[e]	Ask.com[a]	Background	Total	Titan % of total
Maximally impacted	**DEEP**				
Extra-boundary location	0.085	0.0015	0.031846[b]	0.118346	72
Commercial building	0.069	0.0012	0.031846[b]	0.102046	68
Residence	0.007	0.0001	0.031846[b]	0.038946	18
	Acrolein				
Extra-boundary location	0.0020	0.0001	0.009757[c]	0.011857	17
Commercial building	0.0015	0.0001	0.009757[c]	0.011357	13
Residence	0.0009	0.0001	0.009757[c]	0.010757	8
	NO_2				
Extra-boundary location	626	78.25	29[d]	733.25	85
Commercial building	600	75	29[d]	704	85
Residence	356	44.5	29[d]	429.5	83

All concentration estimates are µg/m^3.

a. 2/16[ths] of Titan
b. NATA 2002, Grant Co census tract 9808
c. NATA 2005, Grant Co census tract 9808
d. Ecology
e. Source ICF
f. Revised estimate based on the ratio of the new estimate of MIBR acrolein concentration (0.0020-µg/m^3) given in "*Dec-NOC-Support_Titan_12-30-10_jmw corrections on figures.doc*" to the prior estimate Ecology derived from earlier ICF information (0.0063-µg/m^3)

5.4. Exposure-Response Assessment

Exposure-response assessment is the process of characterizing the potential incidence of adverse health effects in humans resulting from exposure and uptake of toxicants. The process often involves establishing risk-based toxicity values or criteria to use in assessing potential health risk from each toxicant. Exposure-response assessment attempts to consider time-changing exposure magnitudes in whole populations and in theoretically maximally exposed individuals.

5.4.1. Risk-Based Concentrations for Exposed Populations

From laboratory studies of humans and other animals from data gathered from human epidemiological studies, the EPA, the California Office of Environmental Health Hazard Assessment (OEHHA), and the U.S. Department of Health and Human Services Agency for Toxic Substances and Diseases Registry (ATSDR) have developed toxicological values, or risk based-concentrations (RBCs) for some of the TAPs evaluated in this project. The RBCs for the TAPs of potential concern near Titan (identified in Section 5.2) are shown in Table 14.

Table 14. Risk-Based Concentration Values for Comparison with the Modeled DEEP Concentrations

Agency	Type	RBC
EPA[a]	RfC	5 $\mu g/m^3$
	URF	1×10^{-3} to 1×10^{-5} per $\mu g/m^3$
OEHHA[b]	Chronic REL	5 $\mu g/m^3$
	URF	3.0×10^{-4} per $\mu g/m^3$

a. The EPA *Health Assessment Document for Diesel Engine Exhaust* (EPA ORD, 2002) gives a possible range of upper-bound risk of 1 x 10-3 $(\mu g/m^3)^{-1}$ to 1×10^{-5} $(\mu g/m^3)^{-1}$ for lifetime diesel exhaust exposure. However, to date, the EPA has not promulgated a specific point unit risk factor.
b. Listed by ARB as "Particulate Matter from Diesel-Fueled Engines," Scientific Review Panel unit risk "reasonable estimate" = 3.0 E^{-4} $(\mu g/m^3)^{-1}$. Range of unit risks in TAC document was 1.3 E-4 – 2.4 E-3 $(\mu g/m^3)^{-1}$. *California Environmental Protection Agency, Part B: Health Risk Assessment for Diesel Exhaust for the Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant,* California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Section, Oakland, May 1998.

Some of the RBCs used in the current analysis were derived from data on adverse health effects other than cancer. EPA inhalation reference concentrations (RfCs) and OEHHA reference exposure levels (RELs) are derived by methods that are believed to yield exposure concentrations for specified time frames below which non-cancer toxic effects are not expected to happen. The lack of such effects in all humans at these exposure concentrations cannot be confirmed. However, the closer a chemical concentration is to an RfC or REL, the closer it may be to a toxic effect threshold level.

There are also toxicological values derived for estimating toxicant-exposure-enhanced cancer risk. Nearly a third of all people develop some form of cancer at some point in life. The additional risk of cancer posed by exposure to TAPs to be emitted by the project is calculated using these URFs.

National Ambient Air Quality Standards (NAAQS) and other regulatory toxicological values for short-term and intermediate-term exposure to particulate matter have been promulgated, but values specifically for DEEP exposure at these intervals do not currently exist. Even though DEEP is believed to be more acutely toxic than ordinary ambient PM, only risks from chronic exposure to DEEP can be quantified given existing information.

Reflecting uncertainty in their estimates, the DEEP cancer unit risk factors published by EPA, California EPA, IARC, and individual researchers are not identical. The unit risk factors range from 1.4E-2 to 3.9E-4 per $\mu g/m^3$. The narrowness of this range shows there is consistency among the estimates relative to unit risk factor estimates for many other chemicals.

The OEHHA's *Technical Support Document for Noncancer RELs*, June 2008, Appendix D2, Nitrogen Dioxide, pp. 209-214[36] states:

> *"Controlled acute exposure studies with asthmatics show an increase in airway reactivity in response to NO_2 concentrations between 0.25 and 0.50 ppm (0.47 and 0.9 mg/m³). Bauer et al. (1986) reported that NO_2 potentiated exercise-induced bronchospasm and airway reactivity to cold air provocation in asthmatics following exposure to 0.3 ppm (0.6 mg/m³) for 30 minutes. Exposure to NO_2 while at rest resulted in no significant change in pulmonary function. Following 10 minutes of exercise, significant reductions in FEV1 ($p<0.01$) and partial expiratory flow rates at 60% of total lung capacity were observed. One hour after NO_2 exposure and exercise, pulmonary function returned to baseline. Mohsenin (1987) reported an increase in airway reactivity in normal subjects following exposure to 0.5 ppm (0.9 mg/m³) NO_2 for 1 hour. Other studies have reported the absence of airway reactivity in asthmatics at these concentrations (Rubinstein et al., 1990; Avol et al., 1988; Roger et al., 1990).*
>
> *Additional controlled-exposure studies of asthmatics demonstrate an increase in nonspecific airway reactivity following exposure at or below 0.25 ppm (0.47 mg/m³) NO_2. Jorres et al. (1990) report an increase in airway reactivity to hyperventilation of 0.75 ppm SO_2 without altering airway tone following exposure to 0.25 ppm NO_2 for 30 minutes. Kleinman et al. (1983) report an increase in airway reactivity in 2/3 of 31 subjects exposed to 0.2 ppm (0.4 mg/m³) NO2 for two hours. Orehek et al. (1976) report increased airway reactivity in 13 of 20 subjects exposed to 0.1 ppm (0.2 mg/m³) for one hour. Other investigators report no increase in airway reactivity in asthmatics following NO_2 exposure at or below 0.25 ppm (0.47 mg/m³) (Hazucha et al., 1983; Jorres et al., 1991). Results from these studies suggest that a sensitive subgroup of asthmatics with increased*

[36] http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD2_final.pdf#page=209, accessed October 28, 2010

airway reactivity following inhalation exposure to NO_2 may be present in the general population, and that they contribute to the wide range of responsiveness present among asthmatics to inhaled NO_2 (Utell, 1989).”

As noted in Section 5.2, acrolein is a strong respiratory tract irritant.

5.5. Exposure-Response Assessment

In the risk characterization, conclusions about hazards and exposure-responses are integrated with the exposure assessments conclusions. Non-cancer health hazards and cancer risks are quantified and attempts are made to estimate increased likelihoods of these effects in populations exposed to anticipated TAP emissions. In addition, confidence about these conclusions, including information about the uncertainties associated with each aspect of the assessment, is highlighted.

5.5.1. Estimating Cancer Risks

Additional cancer risk may be estimated by estimating the concentrations of a given carcinogen in a location (receptor point) multiplied by the carcinogen’s URF. A URF is expressed as the upper bound probability of developing cancer assuming continuous lifetime exposure to an agent at a concentration of one microgram per cubic meter [i.e., $(\mu g/m^{3)-1}$].

Some URFs are derived from epidemiological human population data. Others are derived from laboratory animal studies involving doses or concentrations higher than likely to be encountered in the environment. When certain assumptions are made, animal data may be used to derive a URF by extrapolation of the cancer potency obtained from a high-dose study to an expected exposure.

Because URFs are usually calculated as continuous lifelong exposure (70 years), it may be necessary to factor different exposure duration and exposure frequency to estimate risk for people exposure primarily in occupational or other less than continuous lifelong exposure scenarios. In general, the formula for determining cancer risk is as follows:

$$\textit{Additional Cancer Risk} = \frac{\underline{CAIR\ (\mu g/m^3)\ x \sum Exposure\ time}}{URF\ (\mu g/m^3)^{-1}} \qquad (1)$$

Where: CAir = Concentration in air at place(s) where people will be exposed to each carcinogen $(\mu g/m^3)$; ∑Exposure time = (hours/24 hours) x (days/7 days) x (weeks/52 weeks) x (years/70 years); URF = Cancer Unit Risk Factor $(\mu g/m^3)^{-1}$ based on continuous life-long (70-year) exposure to 1-$\mu g/m^3$.

5.5.2. Cancer Risk

Cancer risks are reported using scientific notation. The values quantify the increased cancer risk for hypothetically maximally exposed people. For example, a cancer risk of 1.0E-06 means that if 1,000,000 people were exposed to a carcinogen at the given concentration, one additional cancer case might occur in that population. Each person in an evenly exposed population would have their chance of getting cancer increase by 0.0001 percent. Note that these estimates are of cancer risks that might result in addition to those normally expected in an unexposed population. Cancer risks quantified in this document are an upper-bound theoretical estimate.

Ecology did not estimate the number of additional cancers that might result in the exposed population because the number of people who live in the vicinity of the data center is small. When small populations are exposed, population risk estimates tend to be very small. For example, if 100 people were exposed to a carcinogen at a level estimated to cause an additional individual lifetime cancer risk of 1.0E-4, the expected number of additional cancer cases would be 0.01. In such situations, individual risk estimates, but not population risk estimates, are usually more meaningful for decision-makers. The number of additional cancer cases in a given population is not an actuarial prediction of cases in the population. Actuarial predictions are statistics based on much empirical data.

Table 15 shows the estimated worst-case residential and off-site worker cancer risks from exposure to DEEP near the Titan Data Center. OEHHA's URF was used to estimate cancer risks to off-site residential dwellers, teachers or full-time workers at Columbia Basin Secondary School, and people who possibly could be in the outdoor extra-boundary maximum DEEP concentration areas repeatedly over many years.

Table 15. Revised Proposal Estimated Worst-Case Residential and Off-Site Worker Cancer Risks From Exposure to Titan-Attributable DEEP Near the Titan Data Center

	C_{AIR} ($\mu g/m^3$)	Fraction of a 70-Year Continuous Exposure	URF ($(\mu g/m^3)^{-1}$)	Additional Cancer Risk
MIBR	0.073	0.0245[a]	0.0003	5.3E-7
MICR	0.059	0.1308[b]	0.0003	2.3E-6
MIRR	0.0061	1[c]	0.0003	1.8E-6

a. Repeated exposures of 2 hr/day for 250 days/yr for 30 years are assumed for the MIBR. Based on this frequency, the additional cancer risk that would occur if the average concentration of DEEP occurred every time a maximally exposed person was in the MIBR location.
b. Repeated exposures of 8 hr/day for 250 days/yr for 40 years are assumed for the MICR. Based on this frequency, the additional cancer risk that would occur if the average concentration of DEEP occurred every time a maximally exposed person was in an MICR location.
c. A continuous exposure 24 hr/day for 365 days/yr for 70 years is assumed for the MIRR. Based on such an exposure, the additional cancer risk that would occur if the average concentration of DEEP continued to occur in the MIRR location.

Additional cancer risks that result from exposure to regulated TAPs of less than the 1.0E-5 (10 per million**)** are considered acceptable in Chapter 173-460 WAC. At all receptor locations for which information is available, cancer risks attributable to Titan emissions alone are less than 10 per million. The highest estimated cancer risk attributable to Titan emissions alone (2.3E-6 or 2.3 per million) is for workers at the MICR, *i.e.* the Columbia Basin Secondary School.

As shown in Table 16, the highest estimated overall cancer risk at the maximally exposed commercial receptor location posed by the combination of DEEP from Titan, Ask.com, and from existing sources in Grant County census tract 9808, would be 1.2E-5. Of this added risk, most -- 9.6E-6 (9.6 per million) -- can be attributed to existing DEEP sources in the area including Ask.com. 1.2E-5 is the highest risk estimate that could occur for any person exposed continuously for 70 years to outdoor air at the location where the maximally exposed existing commercial building (CBSS) now stands near Titan. However, such a long exposure is extremely unlikely.

Table 16. Cancer Risk Attributable to Titan and Other DEEP Sources

		Exposure time adjusted cancer risk	Sum of DEEP–associated lifetime cancer risks at each receptor location	Titan's increase of DEEP–associated lifetime cancer risk
MIBR	Ask.com	1.1E-08		
	NATA background	9.6E-06		
	Titan	5.3E-07	1.0E-05	5.2%
MICR	Ask.com	4.7E-08		
	NATA background	9.6E-06		
	Titan	2.3E-06	1.2E-05	19.3%
MIRR	Ask.com	3.0E-08		
	NATA background	9.6E-06		
	Titan	1. 8E-06	1.1E-05	15.7%

In the NATA, EPA tried to account for the movements and time spent by people in different microenvironments such as home, work, vehicle travel, etc. In contrast to the NATA ambient concentration estimate for census tract 9808, EPA derived estimates of a range of likely population exposures using the ASPEN derived ambient concentration estimates followed by a second model (HAPEM). For people engaging in daily activities in tract 9808, median background source DEEP exposure (see Table 10) would result in additional cancer risk of 5.2E-6 (5.2 per million). Assuming the URF is accurate and that the 2002 NATA estimate of the background DEEP concentration in census tract 9808 is accurate and will continue to be so for 70 years, the cancer risk posed by Titan's emissions together with the existing DEEP sources will be highest at the MICR as shown in Table 17. The highest reasonable additional cancer risk estimate is 7.5E-6 (7.5 per million). That is,

5.2E-6 additional cancer risk from exposure to existing background DEEP sources
\+ 4.7E-8 additional cancer risk from Ask.com generators without microenvironment exposure adjustment
\+ 2.3E-6 additional cancer risk from Titan without exposure adjustments
= 7.5E-6 (7.5 per million)

Table 17. Additional Cancer Risks Given the Expected Exposure Scenario in Each Location

	ASPEN-Based Risk Estimate	Ask.com Risk Estimate	Titan Risk Estimate	Total Risk Estimate
MIBR	5.2E-06	1.1E-08	5.3E-07	5.7E-06
MICR	5.2E-06	4.7E-08	2.3E-06	7.5E-06
MIRR	5.2E-06	3.0E-08	1.8E-06	7.0E-06

Thus, once Titan's emissions are added to emissions from Ask.com's generator engines and to background DEEP exposure, the overall cancer risk attributable to DEEP exposure at the MICR and other receptors is likely to be less than the 10 per million additional cancer risk limit for a single facility.

5.5.3. Hazard Quotients/Hazard Index

Many air pollutants can harm health in ways other than by causing cancer. Common "non-cancer effects" include problems such as eye and throat irritation, cough, and headache. Effects less commonly include more severe problems such as bronchitis, shortness of breath, and heart arrhythmias, for example. In addition to these, most other organs systems can be affected by some type of air pollutant too.

To determine if Titan's TAP emissions will pose any significant non-cancer effect risks, Ecology screened the TAPs that will be emitted in amounts greater than their SQERs. Ecology limited the screening to TAPs that can affect the same organs as can be affected by TAPs that exceed their ASILs (*i.e.*, NO_2 and DEEP). The organs and organ systems that can be affected by low concentrations of NO_2, DEEP and acrolein are in the respiratory tract (see Section 5.2 above).

The screening procedure entailed calculating a hazard quotient (HQ) for each TAP at each exposure concentration likely to occur for given durations. Ecology used the basic equation:

$$\textit{Hazard Quotient} = \frac{\textit{Time-weighted average concentration } (\mu g/m^3)}{\textit{Risk-based concentration } (\mu g/m^3)} \qquad (2)$$

Except for benzene and carbon monoxide, the TAPs emitted by Titan at rates higher than their SQER may cause broncoconstriction or respiratory epithelium lesions. Ecology screened the combined risk of these effects that may be posed by exposure to these TAPs at the maximally exposed extra-boundary, commercial and residential receptor locations in relation to Titan.

The screening procedure entailed calculation of a hazard index (HI) for increasing exposure durations. In each case, the HI for effects in these organs and tissues was the sum of HQs for each TAP. Ecology calculated these separately for maximum 1-hour and long-term (1 yr) time weighed average (TWA) hazards using the basic equation:

$$Hazard\ Index_{effect} = HQ_{chemcal}\ a + \cdots + HQ_{chemcal}\ z \quad (3)$$

Tables 18, 19 and 20 show modeled concentrations, RBCs, and HQs at each receptor point. All predicted concentrations and risk-based concentrations are in µg/m^3. The HI for each location is the sum of 1-h TWA HQs for NO_2 and acrolein, and the chronic HQ of DEEP. These summed HIs are shown at the end of each receptor's table section.

Table 18. April 2011 Project Proposal-Based Estimates of Non-Cancer Hazards of Titan Emissions at the Maximally Exposed Extra-Boundary Receptor

Nitrogen dioxide conc.	516 (max. 1-hour TWA)		
RBC	REL 470		
HQ	1.1		
DEEP conc.		0.073 (max. 1-yr TWA)	
RBC		RfC 5	REL 5
HQ		1.5E-2	1.5E-2
Acrolein conc.[a]	≈0.0072 (max. 1-hour TWA)		
RBC	REL 2.5		
HQ	2.8E-3		
Hazard Index	Max. 1-hour acute hazard	Chronic hazard	Summed HIs
	1.1	1.5E-2	1.1

Table 19. April 2011 Project Proposal-Based Estimates of Non-Cancer Hazards of Titan Emissions at the Maximally Exposed Commercial Receptor

Nitrogen dioxide conc.	495 (max. 1-hour TWA)		
RBC	REL 470		
HQ	1.1		
DEEP conc.		5.9E-2 (max. 1-yr TWA)	
RBC		RfC 5	REL 5
HQ		1.2E-2	1.2E-2
Acrolein conc.[a]	≈0.00546 (max. 1-hour TWA)		
RBC	REL 2.5		
HQ	2.2E-3		
Hazard Index	Max. 1-hour acute hazard	Chronic hazard	Summed HIs
	1.1	1.2E-2	1.1

Table 20. April 2011 Project Proposal-Based Estimates of Non-Cancer Hazards of Titan Emissions at the Maximally Exposed Residential Receptor

Nitrogen dioxide conc.	293 (max. 1-hour TWA)		
RBC	REL 470		
HQ	0.6		
DEEP conc.		6.1E-3 (max. 1-yr TWA)	
RBC		RfC 5	REL 5
HQ		1.2E-3	1.2E-3
Acrolein conc.[a]	≈0.00324 (max. 1-hour TWA)		
RBC	REL 2.5		
HQ	1.3E-3		
Hazard Index	Max. 1-hour acute hazard	Chronic hazard	Summed HIs
	0.6	1.2E-3	0.6

[a] Estimated acrolein concentrations and hazards based on the original, not the revised, project proposal.

5.5.4. Hazard Indexes Discussion

The information reviewed suggests that acute health effects are possible at certain infrequent times. The primary hazard is from NO_2. At times when unfavorable air dispersion conditions occur coincident with electrical grid transmission failure to Titan, NO_2 HQs may exceed one. If the HQ is less than one, then the risk is generally considered acceptable. The more the HQ increases above one, the more likely it is that adverse health effects will occur by some undefined amount (due in part to how the risk-based concentration is derived).

In light of data from independently replicated controlled laboratory studies of people with NO_2-sensitive asthma, if and when conditions at Titan give rise to HIs of 1.1 at the MIBR or MICR (*i.e*. HI>1), NO_2-sensitive asthmatic people in those locations will be slightly more likely than not to experience asthma symptoms. The maximally impacted areas are outdoors in the vicinity of Titan, at the Columbia Basin Secondary School building, and at the neighboring PepsiCo facility (see Figure 3).

Exposure to NO_2 at concentrations equivalent to the acute REL could increase airway reactivity in some people with asthma. The OEHHA developed an acute reference exposure level for NO_2 based on inhalation studies of people with asthma. These studies found that some subjects exposed to about 0.25 ppm (470 $\mu g/m^3$) experienced increased airway reactivity following exposure (CalEPA, 2008).[37] Not all subjects experienced apparent effects. Like NO_2, DEEP and acrolein may interact with airways in the respiratory tract. Simultaneous exposure to the NO_2, DEEP, and acrolein components of Titan's diesel engine exhausts is likely to result in a higher risk of adverse respiratory effects than exposure to the NO_2 component alone.

It appears Titan will have little effect on convalescent facilities or other locations identified in Section 5.3.2 where people likely to be extraordinarily sensitive to adverse effects of DEEP and NO_2 are likely to congregate.

5.6. Probability Analysis of NO_2 ASIL Exceedances

5.6.1. Distribution of Exceedances

Ecology evaluated all available information to characterize the risk of power failures and coincident atmospheric conditions that would cause the 1-h TWA NO_2 concentration to reach or exceed a toxic level at the current location at greatest risk, the Columbia basin Secondary School (CBSS).

In the original project proposal, ICF presented the range and frequency of NO_2 concentrations possible at the Columbia Basin Secondary School (CBSS) that they obtained from AERMOD simulations. These data are summarized in Figure 14. As shown in Figure 8, the CBSS is the existing edifice with the highest frequency of potential high NO_2 concentrations near Titan.

[37] http://www.oehha.ca.gov/air/hot_spots/2008/AppendixD2_final.pdf#page=209, accessed October 27, 2010

Figure 14 shows the yearly average cumulative distribution of simulated 1-hour time weighted average NO_2 concentrations at CBSS for the 5-year weather record[38] that would have occurred if the new Titan generators had been running throughout the 2004-08 period. The highest simulated 1-hour NO_2 concentration at the CBSS location is 495-µg/m^3. This is relatively less than the highest concentration likely at that location in the original project proposal. In that proposal, atmospheric conditions that would cause the concentration to be 470-µg/m^3 or more occurred 50 times per year in the 5-year period. Conditions that would cause the 1-h TWA NO_2 concentration to reach or exceed 441-µg/m^3 (470-µg/m^3 minus 29-µg/m^3) occurred 71 times per year.

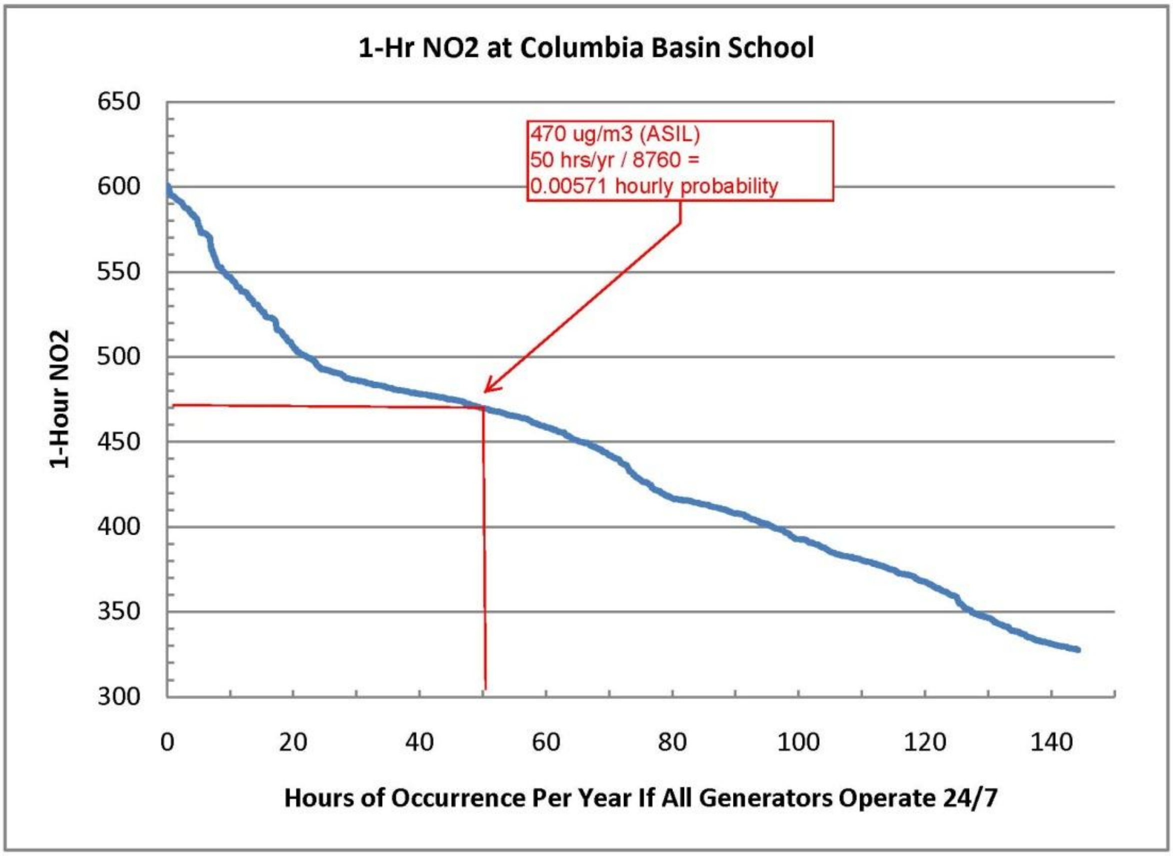

Figure 14. Number of hours per year the 1-hour average NO_2 concentration would have reached given concentrations at the Columbia Basin Secondary School if Titan Data Center generators had run continuously from the beginning of 2004 to the end of 2008.

(*Source: ICF, Second-Tier Risk Assessment for Nitrogen Dioxide (NO2) (Revised for 8 hrs/yr Power Outages, Plus Electrical Bypass Maintenance) Titan Data Center, Moses Lake, WA*)

[38] ICF reported that 43,840 hours were analyzed in the AERMOD simulation. ICF, *Second-Tier Risk Assessment for Nitrogen Dioxide (NO_2) (Revised for 8 hrs/yr Power Outages, Plus Electrical Bypass Maintenance) Titan Data Center, Moses Lake, WA*

ICF did not present revised frequencies and durations of high NO_2 concentrations at the CBSS in their April 2011 submittal; however, they did examine the duration of each 441-µg/m^3 or greater event and the intervals between events in the prior proposal. At any given receptor, 72 hours was the median interval between hours with NO_2 > 441-µg/m^3. This interval between exceedances is more than long enough for recovery from toxic effects of minimally acute NO_2 toxicity. There were 21 events with two sequential hours of [NO_2] > 441 µg/m^3, and no events with three or more sequential hours of [NO_2] > 441-µg/m^3 at the same receptor. Thus, the chance of two-hour long conditions favorable to high NO_2 exposure is less than a third (i.e., 21/71) the chance of one-hour long conditions. The frequencies and durations of high NO_2 concentration events likely to occur at the CBSS are likely to be proportionately less than the foregoing estimates given the revised conditions stated in the April 2011 project proposal.

Of key significance are the hours when Titan emissions would add 441-µg/m^3 of NO_2 to the assumed 29-µg/m^3 background NO_2 concentration. If the generators had been operating at high loads during these hours due to power failures, the toxic effect concentration threshold would have been exceeded.[39]

In the prior proposal, there were 48 five-hour periods during which [NO_2] > 441-µg/m^3 in 3 of the 5 hours. Incomplete recovery from toxic effects of minimally acute NO_2 toxicity could occur under these circumstances in the event of a prolonged power failure; however, based on historical outage information reported below, it is very unlikely that outages and dispersion conditions that favor high NO_2 concentrations will occur on back-to-back hours.

5.6.2. Joint Probability Analysis

As stated above, conditions that would cause the 1-h TWA NO_2 concentration to reach or exceed 441-µg/m^3 occurred 71 times per year. Ecology has not determined if these 71 hours in the 2004 to 2008 period were at times more (or less) likely to occur simultaneously with power outages. If they occurred at times when outages were no more or less likely than average to take place, the probability of generator operation would be independent of the probability of atmospheric conditions that would lead to high NO_2 concentrations at CBSS. A combination of independent probabilities allows evaluation of the joint probability that conditions could occur simultaneously. The joint probability can be estimated as:

$$P(X \cap Y) = P(X) \cdot P(Y) \quad (4)$$

where P(X) is the number of unfavorable atmospheric condition hours that occurred in the 2004 to 2008 period[40] divided by the total number of hours in the same period, i.e.,

$$P(X) = 0.008054028 = 353\text{-h} / 43{,}829\text{-h} \quad (5)$$

[39] ICF estimated maximum 1-hour NO_2 concentrations during pre-scheduled testing and electrical bypass to be 226 and 235 µg/m^3, respectively (exclusive of background). Therefore, pre-scheduled testing and electrical bypass operations are not, by themselves, expected to cause ambient 1-hour NO_2 concentrations > 441-µg/m^3.
[40] The number of times NO_2 concentrations exceeded 441-µg/m^3 in the AERMOD simulation.

and P(Y) is the number of hours during which unplanned outage generator operation takes place divided by the total number of hours considered. Ecology estimated P(Y) by examining possible scenarios under the maximum frequency of outage-caused generator operation to be permitted, i.e., 8 hours per year.

The generators are likely to be operated for ½ hour after each outage triggered start-up but this additional operation is not expected to result in high NO_2 emissions.[41] However, in the event of a higher NO_2 exposure lasting less than one hour, acute effects are still possible in some cases. Since some meteorological conditions could result in concentrations at CBSS higher than the 470-µg/m^3 threshold, toxicity could develop in just ½ hour; however, these meteorological conditions are rare.

For toxic effects to occur under the scenarios described above, the highest feasible frequency is 8 one-hour outages,[42] Thus P(Y), the probability of outage generator operation events given allowance for up to 8 hours of emergency outage operation per year (1 year = 8765.8 hours), is:

$$P(Y) = 9.13E\text{-}04 = 8\text{-h} / 8765.8\text{-h} \qquad (6)$$

The joint probability of meteorological conditions favorable to high NO_2 concentrations at CBSS, and independently occurring power outage generator operation (given the 8-h/y limit on unplanned outage generator usage) is:

$$P(X \cap Y) = 7.35E\text{-}06 = 8.05E\text{-}03 \cdot 9.13E\text{-}04 \qquad (7)$$

Based on this joint probability analysis, the probable recurrence rate of an ambient NO_2 concentration of 441-µg/m^3 at the CBSS over the long term, given full use of the allowance for up to 8 hours of emergency outage operation, is

$$6.44E\text{-}02\ \text{h/y} = 8765.8\text{-h/y} \cdot 7.35E\text{-}06 \qquad (8)$$

That is, Titan could operate generators often enough that, over time, the resulting NO_2 concentration at the CBSS could reach or exceed 470-µg/m^3 about once every 15.5 years.[43]

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[41] According to Titan's proponents, the Titan Data Center generators will be programmed to continue running at idle speed for 30 minutes after Grant County PUD power is restored. While running at idle speed during the cool down period the generators will emit only a small fraction of the NO_2 that is emitted while the generators are providing power to the building during the outage. ICF, *Second-Tier Risk Assessment for Nitrogen Dioxide (NO_2) (Revised for 8 hrs/yr Power Outages, Plus Electrical Bypass Maintenance) Titan Data Center, Moses Lake, WA*

[42] Note that the average customer GPUD experiences 143-minutes outage /year - some more, some less. ICF, *Second-Tier Risk Assessment for Nitrogen Dioxide (NO_2) (Revised for 8 hrs/yr Power Outages, Plus Electrical Bypass Maintenance) Titan Data Center, Moses Lake, WA*

[43] Under the conditions listed in the pre-April 2011 project proposal. Under the conditions listed in the April 2011 project proposal, the recurrence interval would be longer.

5.6.3. Review of Historical Power Failures in Grant County

Ecology obtained a report of recent unplanned generator usage at the Ask.com data center (Moses Lake)[44], the Yahoo! data center (Quincy)[45], and the Microsoft Columbia data center (Quincy) [46]. Table 21 provides a summary of recorded unplanned power outages at the respective data center substations. Each of these data centers are served by the Grant County Public Utility District (GCPUD).

Based on the available records of power failures at data center substations in Grant County, the possibility that Titan will experience the highest feasible frequency power failure of 8 times per year appears unlikely.

Table 21. Record of Unplanned Power Failures at Grant County Data Center Substations

Affected Substation	Date of Outage	Time of day	Duration	Cause
Ask.com* (Moses Lake)	June 10, 2010 (Wed.)	09:40	10 minutes	A PUD maintenance crew-caused event involving a power transformer in the new Dover Substation
	April 28, 2009 (Tue.)	18:07	1 second	A “voltage spike”
	Sept. 10, 2008 (Wed.)	14:48	17 seconds	An upstream utility user caused the disruption
Yahoo! (Quincy)	August 9, 2008 (Sat.)	Not reported	~30 minutes	Lightning
	Oct. 25, 2008 (Sat.)	Not reported	~2 hours	A problem with Intuit/substation coordination
	June 5, 2009 (Fri.)	Not reported	~30 minutes	Lightning
Microsoft (Quincy)	Jan. 22, 2010 (Fri.)	Not reported	Not reported	“Over-voltage”
	Jan. 22, 2010 (Fri.)	Not reported	Not reported	Generators failed to return to inactive mode
	ca. Jan., 2010	Not reported	Not reported	A transformer fire
	ca. Dec. 2009	Not reported	Not reported	A transformer fire and “loss of utility (stray cat event)”

*Ask.com shares a substation with the Titan data center.

[44] ICF, *Second-Tier Risk Assessment for Nitrogen Dioxide (NO_2) (Revised for 8 hrs/yr Power Outages, Plus Electrical Bypass Maintenance) Titan Data Center, Moses Lake, WA*
[45] Email From: Lael Allen; To: Lisa Karstetter; Gerald Allen; Ty Sween; Mark Johnson, Subject: RE: PUD outages since Dec. 2007, Sent: Monday, January 03, 2011 10:17 AM
[46] Email From: Jim Wilder; To: Jack Eaton; David Ogulei; Subject: Unplanned generator usage at MSFT Columbia Data Center, Sent: Wednesday, December 08, 2010 5:04 PM

Each of the three events at the Ask.com data center appears to have been independent of atmospheric conditions. The latter events are alleged to be impossible now that Titan connects directly to the adjacent Dover substation. According to the applicant, Ask.com had no outages in 2007.

Two of the three outage events recorded at the Yahoo! facility appear to have been dependent of atmospheric conditions. However, these conditions probably favored dispersion of NO_2. The third event appears to have been independent of atmospheric conditions.
For Microsoft Columbia, ICF reported limited information for the 4 outages. Two of the four outage events may or may not have been independent of atmospheric conditions. If they were related, it is not clear if atmospheric conditions favored dispersion of NO_2 or not. The other events appear to have been independent of atmospheric conditions. Two or three of the events happened on the same day. This suggests the events were separate in time but raises questions about how close together the events were and how long the generators remained on each time. The "stray cat event" may have resulted from the animal seeking warmth and/or shelter, which would be weather related.

Lightning events are more likely than not when dispersion of pollutants will occur, so poor dispersion and lightning caused outages are likely to be mutually exclusive. Whereas human errors, equipment failures, etc. are likely to be independent of atmospheric conditions unfavorable to NO_2 dispersion *i.e.* they are likely to be independent events. In the combined 8 years of records from the three data centers, 8 presumably atmospheric condition-independent power failures occurred and 2 lightning-caused failures occurred. Thus, one time per year, on average, is the evident frequency of power failures that might have occurred at times when atmospheric conditions might have favored high NO_2 concentrations.

The durations of four of the apparently atmospheric condition-independent power failures were reported to Ecology. Three of these lasted 10 minutes or less, the fourth lasted 2 hours. Reported durations of power failures at data centers in Grant County were 600; 1; 17; and 7200 seconds long. The average reported power failure duration was 32 minutes and 35 seconds or 0.543 hours.

Thus P(Yobs), the probability of outage generator operation events based on actual observations, is:

$$P(Yobs) = 6.19E\text{-}05 = 0.543\text{-}h / 8765.8\text{-}h \qquad (9)$$

The joint probability of meteorological conditions favorable to high NO_2 concentrations at CBSS, and independently occurring power outage generator operation is:

$$P(X \cap Yobs) = 4.99E\text{-}07 = 8.05E\text{-}03 \cdot 6.19E\text{-}05 \qquad (10)$$

Based on this joint probability analysis, the probable recurrence rate of an ambient NO_2 concentration of 441-µg/m^3 at the CBSS over the long term, given observed data center power failures, is:

$$4.37E\text{-}03\text{- } h/y = 8765.8\text{-}h/y \cdot 4.99E\text{-}07 \qquad (11)$$

That is, given actual records of data center power failures in Grant County, Titan is most likely to cause the NO_2 concentration to reach or exceed 470-µg/m^3 at CBSS about once every 229 years, over time.

This expected recurrence frequency of NO_2 concentration at the CBSS reaching or exceeding 470-µg/m^3 may be compared with the recurrence frequency of once every 15.5 years that Ecology calculates based on up to 8 hours of emergency outage generator outage operation allowed per year.

As noted previously, some observed unplanned emergency outage events were reported to ICF by data centers in Grant County and relayed to Ecology. It appears the majority of these power failures were independent of atmospheric conditions. Among these, some were reported with date information. Five of six events were on week days; the 6th was on a weekend day. In addition, 3 events were reported with time of day information; 2 occurred during school hours; the 3rd occurred after hours when the school was likely vacant. Thus, it appears past power failures tend to occur at random times and days of the week and are not more likely to occur when the CBSS is occupied.

Presence at the CBSS for 8 hr/day, 250 days/yr, for 40 years (a total of about 9.13 years) may be assumed for the CBSS staff (students would have significantly fewer years at the school). If the recurrence frequency of once every 15.5 years is valid (as derived from the conditions listed in the pre-April 2011 project proposal) there would be a 59% chance of staff being at the school when generator operation occurs simultaneously with atmospheric conditions unfavorable to NO_2 dispersion. Likewise, if the recurrence frequency of once every 229 years is valid, there would be a 4% chance of staff being at the school when generator operation occurs simultaneously with atmospheric conditions unfavorable to NO_2 dispersion. Under the conditions listed in the April 2011 project proposal, both recurrence interval estimates would be even longer than these original-proposal-based estimates. Ecology concludes the probable recurrence frequency is less than once every 229 years. In addition, the probabilities of high NO_2 exposures occurring for 2 hours or for two 1-hour periods within a 5-hour period are even lower.

5.7. Uncertainty Characterization

Uncertainty may be defined as imperfect knowledge concerning the present and future conditions of a system under consideration. In risk assessments undertaken in support of regulatory decisions, many uncertainties are encountered. Knowledge of these uncertainties allows us to assess the strength of decisions.

Evaluating potential impacts of the Titan project involves several key elements including emissions rate assumptions, air dispersion and fate modeling, estimates of resulting environmental concentrations, exposure modeling to estimate received doses, and exposure-response relationships to estimate the possibilities of different types of health impacts. Each of these elements is encumbered by uncertain science and measurement variability that prevents absolute confidence in predictions about adverse health impacts of this project.

To the extent that people may be exposed to emissions of TAPs from the proposed data center, and despite the uncertainties in concentration estimates, exposure estimates, cancer potency estimates, and irritation hazards, the potential health risks appear to be acceptable. Quantitative assessments of the effects of data center diesel generators emission impacts on human health cannot be made with greater confidence. As in any risk assessment, the current risk assessment involves circumstances of incomplete scientific information. Overall risk uncertainties are summarized in Table 22. The largest sources of uncertainty and variability are:

5.7.1. Emissions Uncertainty

Emissions uncertainty includes measurement uncertainty and process variability. The emissions factors used to estimate emission rates from the proposed new generators are estimates of central tendency of measured emissions from comparable diesel engines. Titan used the EPA Tier 2 average emission limit as emission factors for DEEP and NO_2. The Tier 2-based emission factor is a weighted average of measured emissions from a full engine cycle (five engine loads). At high engine loads, such as occur during emergency operation, emissions of products of incomplete combustion (CO, DEEP, and organic compounds such as acrolein and benzene) are low, while the NO_2 emission factor is relatively high. Conversely, at low loads such as occur during maintenance testing, emissions of products of incomplete combustion (CO, DEEP, and organic compounds such as acrolein and benzene) are high, while the NO_2 emission factor is relatively low.

Table 22. Summary of How the Uncertainty Affects the Quantitative Estimate of Risks or Hazards

Source of Uncertainty	How Does it Affect Estimated Risk From This Project?
Emissions estimates	Likely to overestimate risk initially but to underestimate risk in coming decades
Concentration modeling	Possible underestimate of long-term risks and possible overestimate of acute risks
Exposure assumptions	Likely to overestimate risk slightly
Toxicity of DEEP at low concentrations	Possible overestimate of cancer risk, possible underestimate of non-cancer hazards for extremely sensitive people

The Tier 2 emission factors are governed by low load conditions where generators run poorly, so the Tier 2 emission factors for the products of incomplete combustion (e.g., DEEP) are high. As a result, the Tier 2 emission factor for DEEP is likely to be conservative and overestimate DEEP emissions while the Tier 2 emission factor for NO_2 is likely to underestimate NO_2 emissions.

Emissions factors (EFs) for organic compounds and other toxic air pollutants emitted from large diesel engines are listed in EPA's AP-42. These EFs are just as likely to underestimate as to overestimate emissions. No quantitative description of uncertainty and variability consistent with available data are available.

Further uncertainty in the diesel generators emissions estimates comes from uncertainty in the assumption that dispersion and power failure conditions are independent from each other in Moses Lake. It is possible that weather extremes will trigger power failures in the future. Weather and climatic conditions can damage equipment used for the generation, transmission, or utilization of electrical power. Distribution equipment and transmission lines sometimes fail due to severe weather, ice storms, lightening, as well as human-caused accidents. Various components such as transformers, fuses, switches, insulators, and other system components periodically fail due to aging or other factors. The failure of one sometimes causes cascading overloads in neighboring grid control points.

Emergency operation of the data center diesel generators will be more likely to occur as increasing demand[47,48,49] coincides with increasingly uncertain generation capacity from diminishing stream flows resulting from climate change,[50] and with diminishing reserves of fossil fuel. Consistent hydroelectric power production over the next century in eastern Washington is uncertain. According to a study by the University of Washington scientists:[51]

> "*...substantial changes in the amount and seasonality of energy supply and demand in the [Pacific Northwest] are likely to occur over the next century in response to warming, precipitation changes, and population growth. For the 2020s, regional hydropower production increases by 0.5-4% in winter, decreases by 9-11% in summer, with annual reductions of 1-4%. Slightly larger increases in winter, and summer decreases, are projected for the 2040s and 2080s*."

In general, it appears that the overall risk of emergency generator operation is low now and that it will increase over time. Some of these weather and climate change problems are directly related to DEEP, NO_2 and acrolein dispersion conditions.

5.7.2. TAP Concentration Modeling Uncertainty

TAP concentration modeling uncertainty results from uncertainties about future meteorology, and the measurement variability and applicability of past meteorological conditions of the air data used for the current analyses. Additionally, TAP concentrations uncertainty arises from uncertainty in the precision and accuracy of the air quality dispersion model used: EPA's AERMOD and associated pre- and post-processors. The results of TAP concentration modeling

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[47] In May of 2001, the Bonneville Power Administration asked ten aluminum smelters in the Pacific Northwest to close for two years, to reduce electricity consumption in the area. Reported in The Outlook, WALL ST. J ONLINE, May 21, 2001.
[48] http://openjurist.org/126/f3d/1158/association-of-public-agency-customers-inc-v-bonneville-power-administration-and-utility-reform-proj
[49] Effects of projected climate change on energy supply and demand in the Pacific Northwest and Washington State Hamlet, A.F., S.Y. Lee, K.E.B. Mickelson, and M.M. Elsner, 2009, Effects of projected climate change on energy supply and demand in the Pacific Northwest and Washington State, Chapter 4 in *The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate*, Climate Impacts Group, University of Washington, Seattle, Washington, http://www.cses.washington.edu/db/pdf/wacciach4energy647.pdf
[50] ibid
[51] ibid

in the data center situation are just as likely to be underestimates as to overestimates. The results are central estimates of long-term concentrations and of extreme of short-term concentrations.

Additional uncertainty arises in our estimate of NO_X to NO_2 conversion in the atmosphere.[52] Titan used the PVMRM model to estimate NO_2 concentrations based on an initial NO_2 to NO_X ratio of 10% and an equilibrium NO_X to NO_2 atmospheric conversion rate of 90 percent. Also, due to lack of reliable ozone monitoring data near the data center, ICF assumed a constant background ozone concentration of 40 ppb. These assumptions may have underestimated or overestimated actual NO_2 concentrations resulting from Titan's operations.

5.7.3. Background TAP Concentration Estimates Uncertainties

Background TAP concentration estimates uncertainties result from the uncertainty about the validity of EPA's ASPEN model, and from the possibility that toxic air emissions have changed since 2002 and 2005 (the most recent NATA years). Further uncertainty arises from the geographic scale of the NATA concentration model, which is too large to provide precise results at single census tract scale. NATA results are most reliable when analyzed on a national or state scale, and have increasing uncertainty at smaller county and census tract levels, therefore, concentration estimates at the census tract level may be misleading. Another limitation is that, while EPA has issued Maximum Achievable Control Technology (MACT) standards that are expected to reduce emissions of air toxics from stationary sources, other source categories emissions are generally increasing.

The NATA background concentrations estimates are unlikely to exist at steady levels but are likely to generally increase or decrease in long-term trends. Ecology has no forecasts of future background levels. Further uncertainty arises from the need to add Ask.com generators contributions to background TAP concentrations. Ask.com may increase the data center-attributable TAPs by 2/14th. The TAPs from Ask.com were originally calculated as being 2/16 as much as those from Titan, a 1.8% difference from those that could result in from the Titan project as proposed in the April 2011 revision. In any case, the fraction-addition method of estimating impacts is imprecise. The overall effect of these uncertainties is to reduce confidence in estimates of existing and future toxic air pollutant concentrations in the vicinity of Titan.

No quantitative descriptions of uncertainty and variability consistent with available data are available. The effects of these uncertainties may be underestimates or overestimates of TAP concentrations that will result.

5.7.4. Exposure Uncertainty

Exposure uncertainty results from potential inaccuracies of assumptions about the time people will spend in various locations. Concerning locations that will be affected by Titan's emissions, Ecology assumes a defined intermittent exposure pattern for a hypothetical worker entering the

[52] Most of the NO_X emitted from diesel engines is nitric oxide (NO), which is itself toxic but not considered a TAP in Chapter 173-460 WAC.

MIBR locations routinely. Ecology also assumes a defined intermittent exposure pattern for workers entering the MICRs, and that a person occupying the MIRR will have continuous life-long exposure at that location. The need to ensure that uncertainty and variability are addressed is met by ensuring that the maximal exposures are not underestimated. Conversely, each exposure pattern assumption may overestimate what will actually occur.

5.7.5. Toxicity Uncertainty

Toxicity uncertainty results from potential inaccuracies in the risk-based concentrations used in a risk assessment. RBCs are based on inherently variable experimental toxicology and epidemiological studies. In the process of developing RBCs, there are uncertainties in the assumptions used to extrapolate these data, especially for chemicals with little or no human exposure-response data. Many RBCs are based on animal studies at high levels of exposure.

DEEP is a probable human carcinogen based on evidence from controlled laboratory animal studies that demonstrated its carcinogenicity, and epidemiological evidence among occupationally exposed people that suggests it may cause lung and bladder cancer. The OEHHA URF [53] used in the current analysis may be inaccurate. To avoid underestimating DEEP's true cancer potency, OEHHA based the URF on upper confidence limits of response data. In this way, they attempted to ensure that uncertainty and variability were addressed and to avoid underestimating actual risks. Thus, the cancer risks quantified in this technical analysis are upper-bound theoretical estimates. The estimates of increased cancer risk are the best possible estimates of the upper extremes. The estimates are of cancer cases that might result in addition to those normally expected in a population not exposed to DEEP.

Other sources of uncertainty cited in EPA's health assessment document for diesel exhaust are the lack of knowledge about the underlying mechanisms of DEEP toxicity, and the question of whether toxicity studies of DEEP based on older engines are relevant to emissions from current technology diesel engines.

Ecology's screening of potential non-cancer adverse health effects risks involved comparisons of possible exposures to RBCs, which are estimates of inhalation exposures for humans including sensitive subgroups likely to be without appreciable risks of adverse effects for defined durations. About 10% of Washingtonians are diagnosed with asthma. A subset of these is sensitive to NO_2. At the forecast exposure levels shown in figure 14, mild to moderate effects are possible but life threatening effects of NO_2 triggered asthma symptoms are unlikely. In general, severe asthma effects are relatively rare among people with asthma.

This assessment evaluated the possibility that specific non-caner health risks could arise due to Titan-attributable DEEP, NO_2, and acrolein exposure. Despite the uncertainties in RBCs developed for these TAPs, it is possible that unusually sensitive people will suffer respiratory

[53] A URF is the upper-bound of a confidence interval around, most typically, a mean of expected carcinogenic response at a given concentration. The 95% confidence interval for a mean is the range of values that will contain the true population mean 95% of the time.

irritation-induced airway reactivity when in maximally exposed commercial receptor or outdoor areas during unfavorable air dispersion conditions coincident with emergency operation of Titan's generators for an hour or more.

6. CONCLUSION

Titan's proposed emissions of DEEP could reasonably be expected to increase lung and bladder cancer risk by up to 2.3E-6 (2.3 in one million) for people working full-time for 40 years at the maximally impacted commercial location (*i.e.*, the Columbia Basin Secondary School). For people who will frequently be in maximally impacted extra-boundary and residential locations, the increased cancer risks from Titan emissions are likely to be less than two in one million. The addition of Titan's emissions to existing diesel engine emissions could reasonably be expected to increase overall DEEP-associated cancer risk by no more 7.5E-6 (7.5 per million).

Titan's emissions are unlikely to result in excessive cancer risk but may, on certain infrequent occasions, result in adverse airway reaction symptoms among people with NO_2-sensitive asthma. Other types of adverse non-cancer health problems are unlikely among people at nearby outdoor areas or in the Columbia Basin Secondary School or the PepsiCo facility. People at existing nearby residences are very unlikely to experience non-cancer health effects from Titan-attributable emissions.

Based on the above analysis, the increased cancer risks from the proposed project, as a result of Titan's DEEP emissions, are permissible because they fall within the limits defined in WAC 173-460-090(7).

Given the low lifetime risk of severe asthma symptoms from Titan NO_2 and acrolein emissions and the evidently infrequent recurrence of high NO_2 exposure situations, Ecology concludes that additional mitigation measures are unnecessary; however, Ecology will need routine reports of power failures from Titan to determine the veracity of assumptions in this analysis. The reports shall include the date, time and duration of each power outage and the length of time that each engine operates as a result of the outage. Ecology will also use the power outage records to verify compliance with the 8 hours/year limit on emergency operations. Based on actual power outage records, Ecology may re-evaluate the health risks from this project and, if necessary consider a permit amendment if it is determined that unplanned outages occur more frequently than was assumed in this analysis.

Ecology recommends that Titan schedule a meeting with Columbia Basin Secondary School administrators prior to installation of the engines. The purpose of the meeting will be to communicate, and better understand, any potential concerns or complaints that the school may have regarding generator maintenance testing and operation. The meeting should also be used to communicate potential risks from generator operations. Also, Titan should provide the school administrators with a direct telephone contact to one of the Titan Data Center managers. The school administrators should also be provided a maintenance testing schedule for the generators. Titan will update the school whenever the testing schedule changes. As decided by the school administrators and Titan, an ongoing relationship between the school and Titan should be established.

Future decisions about development and use of the land area around the data center should consider potential impacts of data center emissions on human health.

Therefore, based on the technical analysis described herein, the additional health risks attributable to Titan's DEEP, acrolein and NO_2 emissions will be permissible under Chapter 173-460 WAC provided:

1) health risks posed by Titan operations are communicated to potential new homeowners in the most heavily impacted parcel north of the Titan Data Center (i.e., Parcel No. 171029000 in Figure 11) and/or the local regulatory agency responsible for zoning and development in the affected area;

2) the proposed engines are operated no more than described herein;

3) the emission rates relied upon for modeling ambient impacts are not exceeded; and

4) Titan routinely reports to Ecology all unplanned power failures occurring at the Titan facility.

The project review team recommends approval of the proposed project in accordance with WAC 173-460-090(7), subject to implementation of the above recommendations.

7. LIST OF ACRONYMNS AND ABBREVIATIONS

AERMOD	Air dispersion model
AREL	Acute Reference Exposure Level
ASIL	Acceptable Source Impact Level
ATSDR	Agency for Toxic Substances and Diseases Registry
BACT	Best Available Control Technology
C	Celsius
CASRN	Chemical Abstract Service Registry Number
CBSS	Columbia Basin Secondary School
CO	Carbon Monoxide
Conc.	Concentration
CAir	Concentration in air
CREL	Chronic Reference Exposure Level
DEEP	Diesel Engine Exhaust Particulates
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ER	Emission Rate
HIA	Health Impact Assessment
HQ	Hazard Quotient
h or hr	Hour
ICF	ICF International
lb or lbs	Pounds
Max.	Maximum
MIBR	Maximally Impacted Boundary Receptor
MICR	Maximally Impacted Commercial Receptor
MIRR	Maximally Impacted Residential Receptor
$\mu g/m^3$	Micrograms per Cubic Meter
MRL	ATSDR Minimal Risk Level
NAD27	North American Data of 1927
NATA	National-scale Air Toxics Assessment
NO_2	Nitrogen Dioxide
NOC	Notice of Construction Order of Approval
NO_X	Oxides of Nitrogen
NWS	National Weather Service
OEHHA	California's Office of Environmental Health Hazard
PSD	Prevention of Significant Deterioration
RBC	Risk-Based Concentration
REL	OEHHA Reference Exposure Level
RfC	Reference Concentration
SQER	Small Quantity Emission Rate
TAP	Toxic Air Pollutant
tBACT	Best Available Control Technology for Toxics
Titan	RS Titan-Lotus, LLC, or Titan Data Center
TWA	Time-weighted Average

TWP	Concentration Time Weighted Average Period
UF	Uncertainty Factor
URF	Unit Risk Factor
WAC	Washington Administrative Code
y or yr	Year